THE ENGINEER

The International Machine Tool Exhibition at Olympia

Descriptive Supplement No. I

THE International Machine Tool Exhibition organised by the Machine Tool Trades Association opens at Olympia on Wednesday next, September 17th, and will be open daily from 9.30 a.m. to 6 p.m. until Saturday, October 4th. This exhibition will be one of the largest of its kind yet held, and in it there will be shown some 2000 machine tools and woodworking machines, together with a wide range of auxiliary equipment and accessories. Not only will a majority of the firms making machine tools in this country be represented, but a large number of importers will be showing machines from the United States, France, Belgium, Italy, Germany, Switzerland and other countries. The exhibition provides an unequalled opportunity to see the development in all aspects of machine tool design which has taken place in the four years since the previous exhibition at Olympia. Users of machine tools at home and buyers from countries from all over the world who have been invited will be able to inspect not only the products of the various British firms, but also those of many leading manufacturers abroad. The British machine tool industry will be well represented, and from preliminary information, upon which the descriptions in this Supplement are based, it is evident that despite the many difficulties experienced as a result of the Defence programme, the standards of design and quality maintained for so many years continues at a high level. This fact was confirmed last year by the export figures, which showed that countries abroad purchased machine tools to a total value of no less than £18,039,700 from Britain. Although it might be pointed out that we imported machine tools to the value of nearly £15,263,000 during the same period, this was primarily caused by the quantitative requirements of the defence programme and the limited productive capacity of the industry. The export trade of the industry is being maintained despite its difficulties, and once the demands for defence are satisfied and materials flow more freely there is little doubt that in the not too distant future we should be in a position to compete still more widely in world markets and reduce imports of machines.

In this Supplement we give particulars of some of the machine tools which will be on show at Olympia. In a second Supplement next week and subsequently in the pages of THE ENGINEER, more descriptions will be given. But with the amount of space which can be fairly devoted to the exhibition it would be quite impossible, without reproducing brief catalogue details, to mention all of the machines or the makers represented. We have, therefore, decided to cover a selection of the different machines of improved or new designs in order to give a general impression of the size and scope of the exhibition and the trend of development, and to note individual points of particular interest to the majority of prospective users.

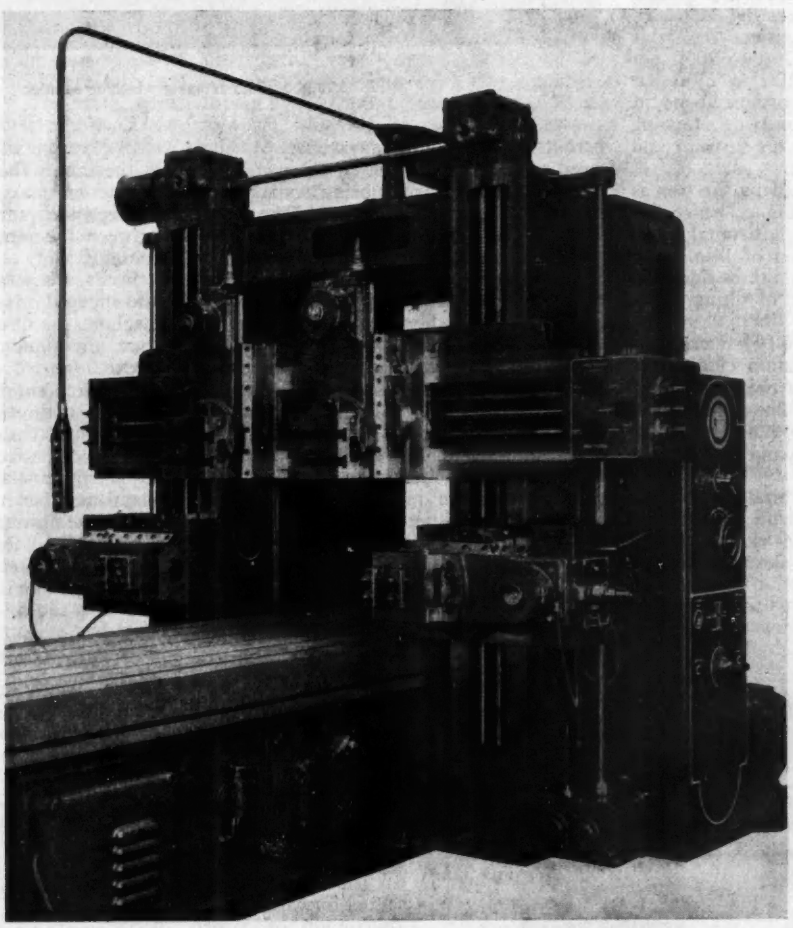


Fig. 1—Spiral Electric Planer—Butler

The Butler Machine Tool Company, Ltd.

The Butler Machine Tool Company, Ltd., of Mile Thorn, Halifax, has for many years specialised in the design and manufacture of planing, shaping and slotting machines, which it makes in a wide range of sizes. From its larger machines the firm has selected for exhibition one of its spiral-electric planers with a 4ft 6in wide bed. This class of machine, which is made in a complete range with tables from 3ft to 9ft 6in wide and any specified length, has been recently redesigned to improve appearance, performance and ease of control.

The machine to be exhibited is illustrated in Fig. 1, and it has a 12ft long table carried on a 24ft long bed with 2ft 9in vee centres. As can be seen from the photograph it is fitted with two toolboxes on the cross slide and a side toolbox on each upright. The main 45 h.p. motor drives the first worm of the spiral drive through a flexible coupling, and engaging with this worm is a hollow-faced phosphor bronze worm wheel keyed to a heavy driving shaft passing diagonally into the bed of the machine. This shaft carries the main steel worm gearing with the cast iron table rack.

The two toolboxes on the cross slide can be fed in the same direction, towards or away from one another, mechanical clutches at the cross slide end in conjunction with the electrical reverse on the control panel being used for selecting the required direction. Vertical feed is taken from a common shaft with independent mechanical engagement on each toolbox, and all feed screws are fitted with double nuts and micrometer collars which can be set and locked in position. A complete toolbox can be swivelled through 120 deg., and its clapper box through 180 deg., and each box

is fitted with a built-in solenoid giving an adjustable lift.

The feed and power traverse unit is operated from a reversible d.c. motor which is connected to the front side toolbox and the cross slide through a spiral bevel gearbox and a vertical splined shaft, while the rear side toolbox is driven through a shaft running through the bed to a second spiral bevel gearbox and vertical splined shaft.

The cross slide is locked electrically through a ½ h.p. motor unit controlled from the feed panel, where indicator lamps show the locked or unlocked position. Locking is effected through screws and two steel clamps bearing on floating shoes which are self-setting against the inside face of the columns. The locking motor is electrically interlocked with the table so that neither the table nor the elevating motor can be started with the slide unlocked.

The cross slide is elevated or lowered by a 2 h.p. motor which drives the elevating screws through two totally enclosed worm reduction units. Horizontal setting of the cross slide is effected from fine thread nuts on top of each elevating screw. Electric limit switches are provided to prevent the cross slide fouling the side toolboxes or elevating brackets. An electric tachometer registers the table speeds, which range from 20ft to 200ft per minute when cutting or 110ft to 220ft per minute on return. A portable pendant switch provides control for starting, stopping and inching the table, and for forward and reverse of the power traverse.

A new machine introduced by the firm is the 26in shaper shown in Fig. 3, which has a 26in by 36in table with a horizontal travel of 30in and a vertical travel of 14in. The standard table has tee slots on three sides and special designs of swivelling or tilting tables are available.

This machine is driven by a 10 h.p. constant speed motor through a friction clutch, vee ropes and an eight-speed gearbox giving from 9 to 100 cycles per minute. The single helical stroke wheel revolves round a large fixed bearing in the body and has an extra bearing for the spindle.

Alteration of the stroke and the position of the ram can be effected with the machine in motion or at rest, feed changes being obtained through a cam mechanism which permits adjustment at any time. A single lever selects feed or power traverse to the table, the power traverse being available with the ram in motion or at rest. The feed is applied horizontally to the table and a vertical toolbox feed is operated from an adjustable friction quadrant on the ram. Lubrication of the drive, feed motion and ram slides is by gear pump fitted with suction and delivery-filters.

The firm makes three sizes of precision toolroom slotters with 4in, 8in and 12in strokes respectively, and it guarantees that these machines have a maximum error of 0·0005in for the ram alignment and table traverses. The 8in stroke machine to be exhibited (shown in Fig. 2) is driven by a 3 h.p. constant-speed motor mounted inside the base and driving through vee-ropes and a dry-plate clutch to a four-speed gearbox, giving a range of 40, 54, 75 and 105 strokes per minute.

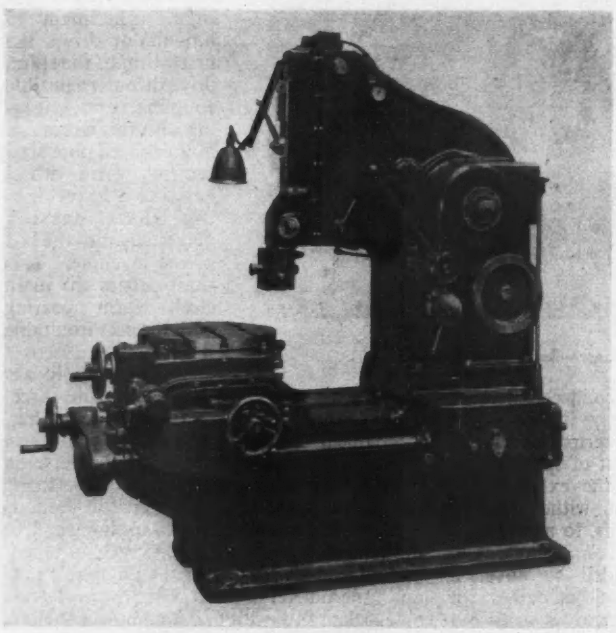


Fig. 2—8in Toolroom Slotting Machine—Butler

In this machine the single helical stoke wheel has a new design of driving block enveloping the vee-slide and providing a large diameter driving pin, whilst the slotted link incorporates the ram balance weight.

The ram can be tilted forward up to a maximum of 5 deg. and is located vertically against a dead stop. It carries a steel toolbox which can be swivelled through 360 deg. This toolbox has a built-in relieving motion which operates with the tool in both vertical and horizontal positions.

The stroke can be altered with the ram in motion or at rest, and the position of the stroke can be adjusted from a squared hole in the ram. The ram has an adjustment of 10in, the maximum admittance distance between the ram and table being 16in, and between the ram face and the frame horizontally, 19in.

Feeds are selected from a slotted disc and engaged or reversed from the front of the machine, the direction of feed being selected from the clutch levers on the individual screws.

The circular table is provided with a driving mechanism through twelve divisions, operated by a plunger built into the front of the square slide, and the feed worm can be disengaged to facilitate hand operation. The 20in diameter table has a 20in longitudinal and transverse movement and micrometer collars are fitted to all feed movements. Lubrication of the drive and ram is by gear pump and a nipple system lubricates the feed motion and table slides.

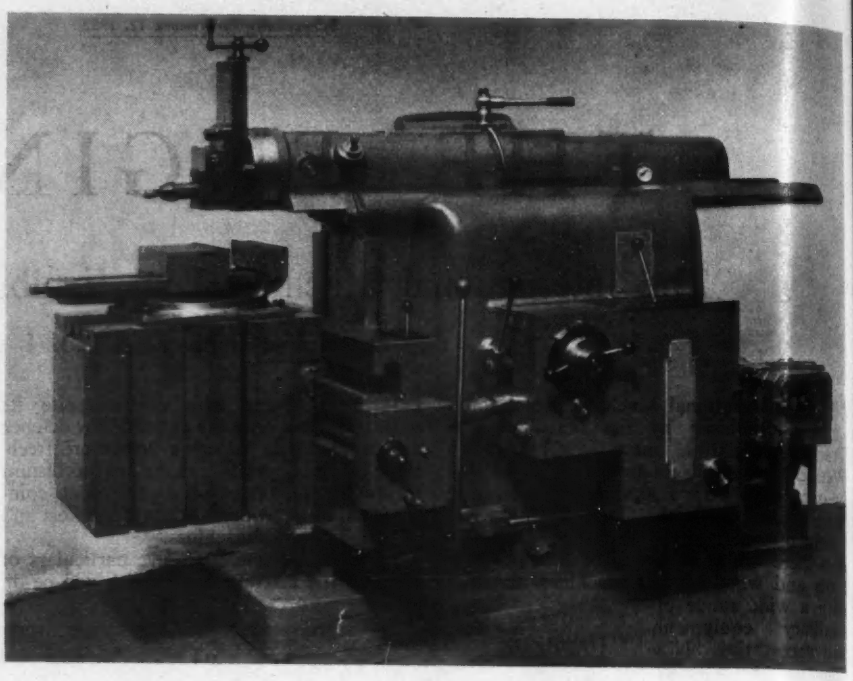


Fig. 3—26in Shaping Machine—Butler

Adcock and Shipley, Ltd.

The twelve machines selected for exhibition by Adcock and Shipley, Ltd., of Ash Street, Leicester, include an interesting special deep hole drilling machine, which has been developed for step-by-step drilling of components having holes which are very long in relation to their diameter. Although the machines are of special design they can be arranged for handling a variety of components. One of the machines is illustrated in Fig. 4.

Each machine of this design has a rigid base carrying a box-section bed with a vee-slide at each end on which a drill head slides in a horizontal plane. A platform on the bed between the two slides carries a fixture designed to hold the particular components to be drilled. The drill units are fed along the bed by hydraulic cylinders mounted behind the vees, and they have built-in 1¼ h.p. rotor stator units to drive the multi-spindle drill heads. The spindles are mounted in special dual-purpose ball bearings and are bored to receive adjustable sockets or collet drill holders as required.

When the machine is operating the feed takes place in steps, the depth and number of which can be varied to suit the class of mater-

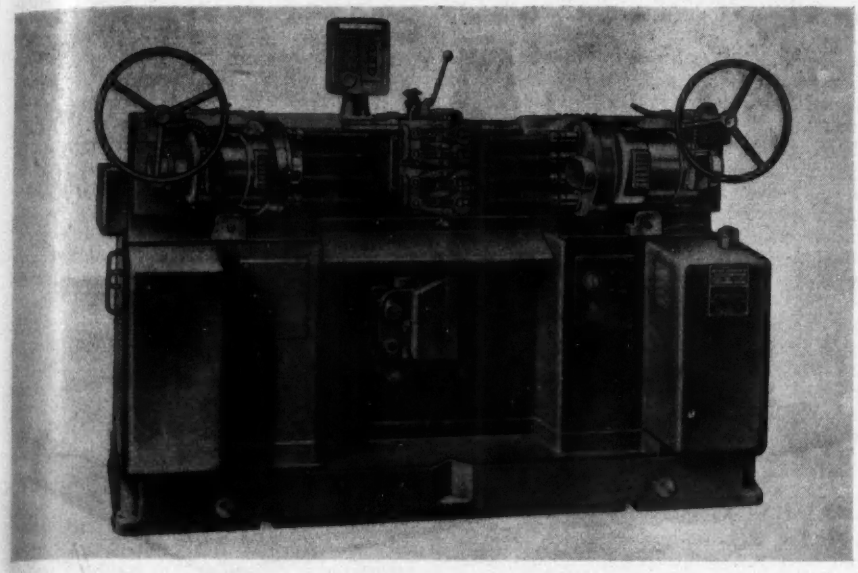


Fig. 4—Deep Hole Drilling Machine—Adcock and Shipley

ial being drilled. Between the steps the drills are rapidly withdrawn from the work to allow coolant, delivered under high pressure, to clear the holes of swarf. The drills then return at the rapid traverse rate and the drilling operation continues. The hydraulic feed circuit is specially balanced to enable the drills to be controlled during breaking through, so that drill life is prolonged and the risk of drill breakages is reduced.

Control of the machine is effected through push buttons and toggle switches mounted on a panel above the bed which is easily accessible to the operator. An indicator light shows when the hydraulic pump is running and the pump motor is interlocked so that the operating cycle cannot commence until the motor is actually running. An overriding control is provided to stop the machine and return the heads to their outer positions in an emergency. Coolant is supplied by a built-in motor-driven centrifugal pump of ample capacity to force coolant to the drill guide bushes and up the holes.

The drilling procedure with this machine naturally varies with the type of component to be drilled, but in the case of the machine being exhibited the components are loaded into the indexing turret fixture at the loading and unloading station and the turret is then indexed to bring the loaded fixtures into the operating position. Upon the start button being pressed, the heads to approach at a rapid traverse rate of 300in per minute, change to drill feed rate automatically before the drills strike the components, and then drill a predetermined depth into the components. When this depth is reached, the heads retract at 300in per minute until the drills have cleared the holes. This allows the coolant to wash out the swarf from the holes before the heads return at 300in per minute, changing to drill feed rate just before the drills contact the ends of the holes.

Whilst drilling proceeds, the fixtures in the unloading and loading positions are unloaded and loaded ready to repeat the cycle. When the components in the operating station have been drilled to the required depth, the machine stops automatically with the heads in the outermost positions.

The useful range of milling machines upon this stand will include the heavy-duty horizontal machine which is shown on Plate 3 and can be supplied as either a plain or a universal unit. It is specially designed and can be powered for working with tungsten carbide or negative rake cutters. When required for very heavy duty work the machine is driven by a 25 h.p. motor and has a built-in flywheel, whilst for normal heavy-duty work it is fitted with a 10 or 15 h.p. motor.

The table of this machine has an overall working surface of 72in by 17in, and it has a longitudinal traverse of 44in, a transverse traverse of 15in, and a vertical traverse of 19½in. It has twin overarms 5in diameter, and can take cutters up to 16in diameter clearing the overarms. Drive from the motor is through multiple vee belts to the main gearbox and twenty-four spindle speed changes from 23 to 1260 r.p.m. are provided. A considerable increase in spindle rigidity is imparted by an additional bearing fitted at the centre. A large final drive wheel situated directly behind the spindle nose bearing gives a flywheel effect, which is of great value when using carbide cutters on the machine.

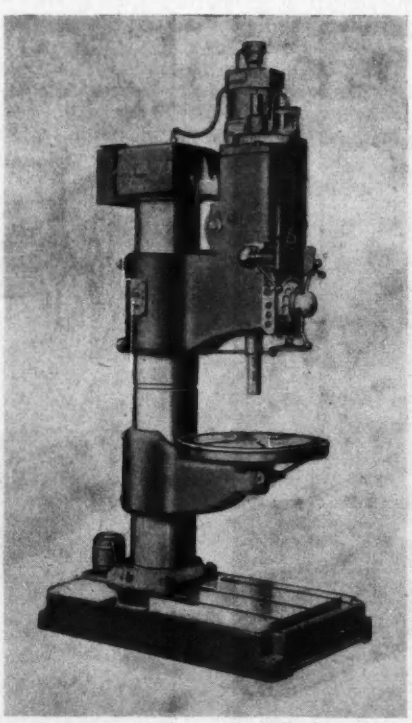


Fig. 5—28in Elevating Head Drilling Machine—Adcock and Shipley

An infinitely variable feed change gives a stepless range of feeds from $\frac{7}{16}$in to 63in per minute in the longitudinal and transverse directions, and ½in to 16in per minute in the vertical direction. Rapid traverse is fitted for all directions of table movement. The machine exhibited is fitted with a backlash eliminator which makes it particularly suitable for climb milling.

One of the drilling machines to be exhibited is of the firm's elevating head design, in which both the head and the table can be moved up and down the column. As can be seen in the photograph reproduced in Fig. 5, the head is carried on a short rigid arm which can be moved by power up and down the column and, through an interlocking mechanism, this head is automatically locked in position after setting. This 28in machine takes drills up to 2in diameter and the spindle has sixteen speeds from 19 to 1360 r.p.m. with six feed rates from 240 to 30 revolutions per inch.

The maker considers that this machine with its sliding head arrangement can be used for work which is often done on radial drills or horizontal boring machines when use is made of suitable fixtures and boring bars. They point out that a radial drill is often used, not because it is possible to move the drill spindle about in relation to the work, but rather because the arm can be raised and lowered by power. The elevating head drill, in addition to having this movement, has also the advantage of greater rigidity as the distance from the spindle to the column is much less than on a radial drill.

Kendall and Gent, Ltd.

Large plano-milling machines weighing up to some 300 tons have been made by Kendall and Gent, Ltd., of Gorton, Manchester, and a good impression of this class of machine is given by one weighing 50 tons to be shown in the exhibition and illustrated in Fig. 6. This machine has a table 12ft long by 5ft wide and admits work up to 5ft high under the vertical spindle noses.

Each of the three milling heads is driven by its own 20 h.p. motor, and sixteen spindle speeds from 10 to 206 r.p.m. are available. This range is suitable for the machining of practically all materials and makes possible negative rake or normal milling as required. The spindles are mounted in precision antifriction bearings, and adequate thrust bearings take the tangential and upward thrust forces of the cutting action.

The milling heads can be traversed along their respective slides in each direction both by power feed and by rapid power traverse through a separate motor-driven gearbox mounted on the right-hand end of the cross slide. Eight rates of feed are provided by the gearbox to both the vertical and the horizontal milling heads, and together with the two-speed motor it gives a total of sixteen feeds in a range of ¾in to 18in per minute. Hand traverse can also be used for fine setting with reference to dials reading in thousandths of an inch.

The bed, cross stay and uprights of high-grade cast iron have all slideways chilled, and are secured together to form a rigid structure to withstand the cutting forces on the milling heads from whichever direction they are imposed. The cross slide supporting the vertical milling heads is equipped with "bows" in both the vertical and horizontal planes to counter bending stresses.

Final drive to the table is by a worm and segmental rack drive unit, giving a constant rate of feed and uniformly smooth move-

ment. The table is driven by a 7½ h.p. two-speed motor through an eight-speed gearbox, giving a total of sixteen feeds in a range of ¾in to 18in per minute. In addition, constant speed rapid power traverse and hand motions are provided in both directions for setting. A trip motion is incorporated, allowing the table to be stopped at any predetermined point.

The elevating motion to the cross slide carrying the two vertical milling heads on this machine has been re-designed and the whole of the mechanism is built into the casting to eliminate the use of exposed shafts and couplings. Control of the machine has been simplified, so that all movements of the table are regulated by duplicated joystick levers on both sides of the bed, and by the movable pendant electrical push-button station. Controls for the traverses of the milling heads are conveniently situated on the end of the cross slide within easy reach of the operator.

One of this firm's "C.V.M. 60" vertical milling machines to be exhibited is shown on Plate 3. It is particularly intended for use with carbide cutters and incorporates the power and stability to take full advantage of modern tungsten carbide milling technique. In this machine, the self-contained unit milling head carries the 40 h.p. main drive motor and on it the large spindle is carried in a special arrangement of roller bearings which take the radial load whilst a large double-thrust washer bears the reaction of the cut and also supports the weight of the spindle. Eighteen spindle speeds are provided, from 15 to 840 r.p.m., and change of speed is accomplished by the single lever on the right-hand side of the head. A large diameter sleeve carries the spindle with the main bearings, and is equipped with micro-hand adjustment for setting the depth of cut. The sleeve mounting of the spindle housing gives a short spindle length with minimum distance between spindle drive and cutter, with consequent low spindle torque. A large diameter dial indicator, providing adjustable means of depth control, eliminates the need for constant checking of the work on the table and enables the operator to set the cut to within close limits. A series of stops can be used to adapt the machine for a sequence of operations and the indicator can also be used as a dead stop.

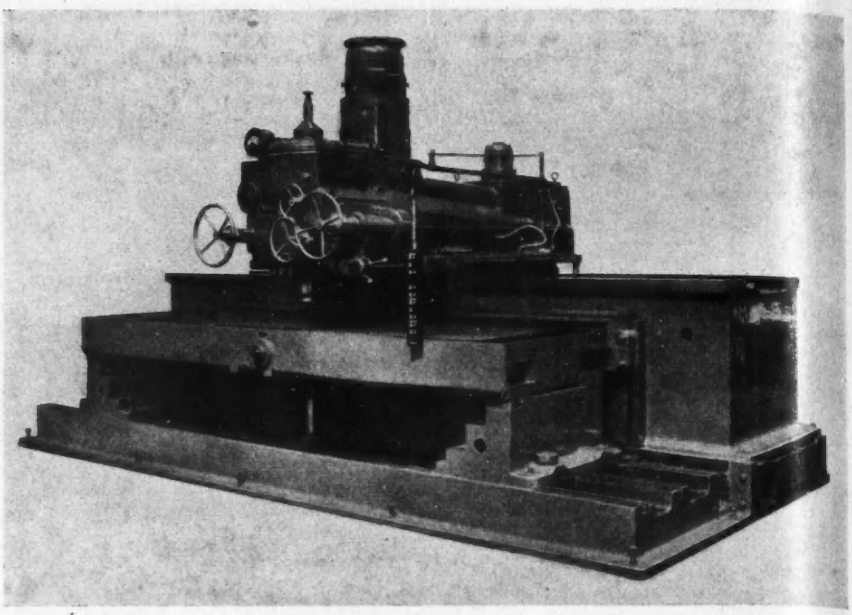


Fig. 8—Vertical Milling Machine—Kendall and Gent

The spindle nose is flanged for direct mounting of face milling cutters, and is bored to the standard No. 50 International non-stick cone.

A substantial base is arranged with the main sliding surfaces and table guides directly under the milling spindle to give good table support under cut, whilst two auxiliary sliding surfaces ensure the necessary stability of table. The table has a working surface 9ft long by 2ft 9in wide and its maximum setting distance from the spindle nose is 3ft 5in. The table feeds are reversible and obtained from a constant-speed motor, coupled through suitable reduction gearing to the change feed box. This box, which is mounted under the left-hand end of the table, with a clearly numbered direct-reading feed change indicator, gives eight feeds from 1½in to 18in per minute for each spindle speed.

The direction of the table traverse is controlled electrically by push buttons carried in the pendant and is so arranged that it is impossible for conflicting motions to be engaged. The feeds can be tripped at any predetermined position in both longitudinal or transverse direction by means of adjustable stops.

The table itself is of deep section, with tee-

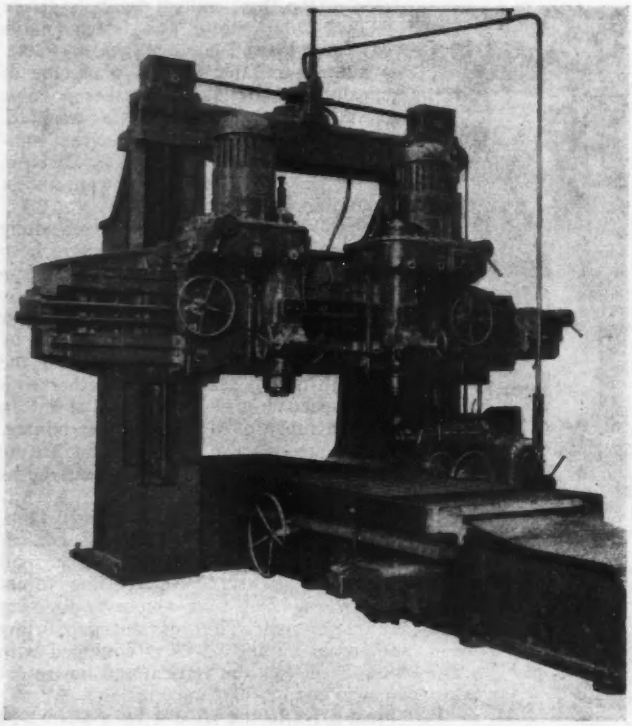


Fig. 6—Plano-Milling Machine—Kendall and Gent

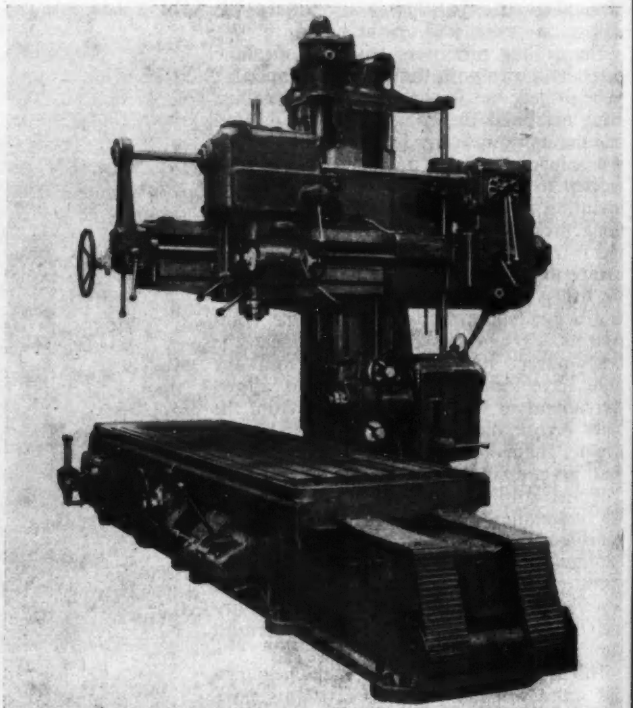


Fig. 7—3in Open-side Milling Machine—Kendall and Gent

slots cut from the solid and coolant troughs with strainers are provided. Longitudinal traverse is transmitted through worm and semi-circular rack, and in-traverse by a large-diameter steel screw. Hand adjustment to both table movements is controlled by large handwheels duplicated at the rear of the table.

All handwheels are clutch operated and when engaged a lever mechanism cuts out the power circuit to the table traverse motor, thus making it impossible for the table to operate on power traverse when any handwheel is engaged. Rapid power motion for quick table movement is provided in all directions.

Control of all motions has been simplified so as to require only two levers and the pendant push-button station. One lever engages either the feed traverse or rapid power traverse, whilst the other lever selects the particular motion required. Directional selection, and starting and stopping, are controlled from the pendant push-button station.

The 3in open-side, vertical and horizontal milling machine to be seen in Fig. 7 differs from the firm's standard model in that the change gearboxes on the table traverse and vertical milling head traverse have been replaced by an electronic drive, giving infinitely variable feeds.

As the machine is fitted with one milling head on the cross slide and one on the upright, several operations can be done simultaneously at one setting. The utility of the machine is further advanced by the provision of a boring feed to the vertical spindle.

The table is driven by a d.c. motor, the speed of which can be infinitely varied through the electronic control to give a range of feeds from 1·42in to 21in per minute, and there is a constant rapid power traverse for setting purposes. In this control, potentiometers fitted to the control desk at the side of the machine, provide instant feed changes, and immediately the rapid power traverse button is depressed for either direction the potentiometer control is by-passed and the motor speeds-up to give the rapid traverse to the table.

Infinitely variable vertical milling head feeds from 1·5in to 22in per minute are obtained by electronic control in a similar manner to the table movements. The horizontal head has a standard mechanical feed unit through which three changes from 1¼in to 6in per minute are obtainable. In each milling head twenty-seven spindle speeds from 20 to 1080 r.p.m. are available.

The control of the machine has been considerably simplified by the provision of the electronic drive. Push buttons, reversing switches and potentiometers are mounted neatly on a control desk fitted to the side of the machine, and a pendant also provided carries the main control buttons. In the control gear the main driving and the table traversing motors are electrically interlocked so that failure of the spindle motor through overload or any other reason automatically stops the table.

In 1949 this firm introduced a vertical milling machine which broke away from traditional design and, as a result of experience with it in production, a number of improvements were incorporated in the machine (illustrated in Fig. 8). As can be seen, this machine has a heavy base plate to which is rigidly bolted the bed casting on which the milling head slides. The worktable is a rigid casting which is elevated by a 5 h.p. motor and supported at each end at the required level on stepped pillars adjustable longitudinally by a tommy-bar-operated rack and pinion gear.

The milling head has a longitudinal traverse of 13ft and a transverse traverse of 3ft to give a wide range of spindle settings over the 12ft by 3ft table. A 30 h.p., two-speed motor is fitted on the milling head, which is completely self-contained, carrying all the spindle driving and feed and traversing mechanism. The spindle gearbox gives eight changes, which, together with the two-speed motor, provides a range of sixteen separate speeds from 15 to 310 r.p.m. A single lever only is used to set for any speed.

The spindle feed gearbox is carried at the rear of the milling head and powered by a separate 5 h.p. motor. Eight changes of feed from 2in to 24in per minute are obtained entirely independent of the spindle speed, and a rapid power traverse of 45in per minute is provided for setting purposes.

J. Parkinson and Son (Shipley), Ltd.

One of the three conventional universal milling machines which will be shown on the stand of J. Parkinson and Son (Shipley), Ltd., of Shipley, Yorks, is fitted with an independently motor-driven universal milling head on a special overarm, as shown on Plate 3. This head can be swivelled through a full 360 deg. on two axes that are at right angles so that the spindle can be presented at any angle to the work. The spindle is driven through sliding gears controlled by a small handwheel at the side of the overarm and the sixteen spindle speeds available range from 44 to 1800 r.p.m. The spindle is bored No. 40 taper, and it has a 3in axial movement operated by a screw nut and handwheel, to provide for fine adjustment and for drilling at any angle.

This firm's "Adapta" miller (Fig. 9) can be used for a very wide range of work as its cutter head can be swivelled 90 deg. between horizontal and vertical on its ram, which is carried in slideways on the top of the column. The 19in movement of the ram combined with the cross traverse of the table enables the cutter spindle to cover an area 29in wide. With this adjustable ram only short arbors need to be used for horizontal milling, as the cutters can be usually mounted near the spindle.

The spindle, which has a 3in axial movement, is driven through vee-belts by a 2 h.p. reversible motor, which is interlocked with the 1 h.p. motor driving the traverse motions of the table. Twelve spindle speeds, from

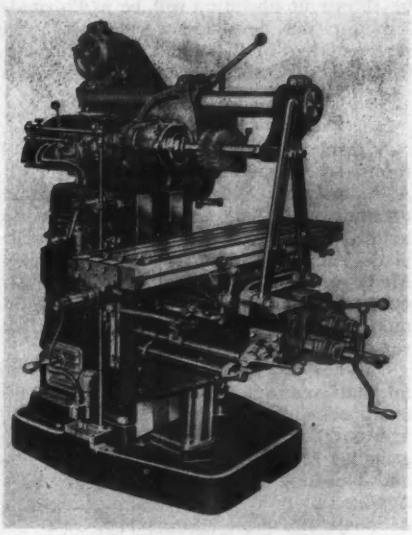


Fig. 9—"Adapta" Miller—Parkinson

43 to 1000 r.p.m. are available in each direction. As can be seen in the illustration, an overarm and arbor support are used to provide an outer bearing when the machine is used as a horizontal miller. The 52in by 12¾in table has twelve feed rates, from $^{9}/_{32}$in to 15in per minute longitudinally and transversely, and from ¼in to 6¾in per minute vertically. Rapid traverse is available in all directions.

Two of the firm's well known "Sunderland" gear planers are to be shown in operation on the stand. One of these machines, the No. 19, is designed to cut spur and spiral gears up to 56in diameter, 9in face and 1½ D.P., and can be fitted with an attachment for cutting double helical gears. This machine (Fig. 10) will be shown working on steel castings and using the double acting method of cutting. In this method, two cutters, one a "bottoming" and the other a finishing cutter, are mounted back-to-back in the cutter box. With this arrangement, the machine operates on both strokes, and, in addition to reducing wear and tear on the machine, it enables faster feeds to be used with a consequent reduction in cutting time.

The "Parkinson" gear testing machine to

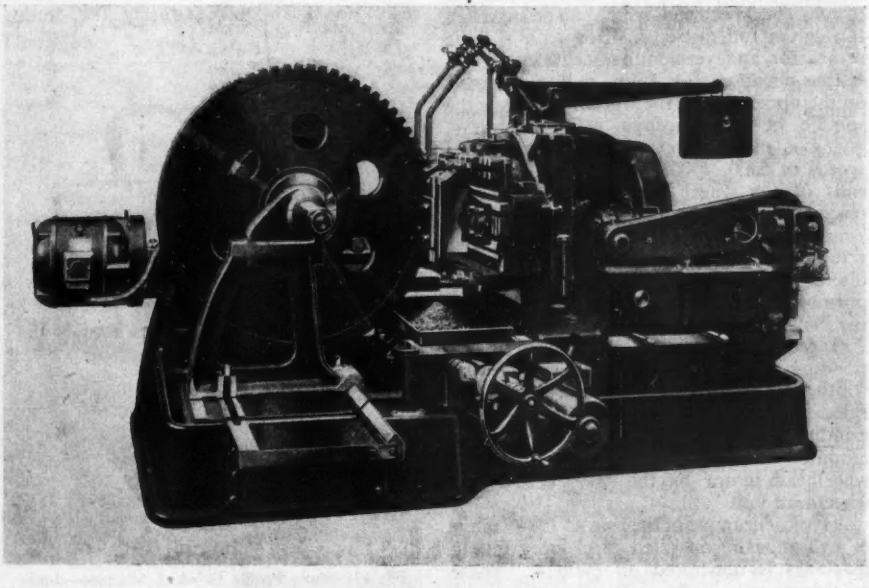


Fig. 10—"Sunderland" Gear Planer—Parkinson

be shown in operation will be a 9in model "B" for spur, bevel and worm gears, and is representative of the range of machines the firm makes for testing gears up to 30in dia.

Jones and Shipman, Ltd.

A display of precision grinders for toolroom and production work will be shown by A. A. Jones and Shipman, Ltd., of Leicester, together with "Ex-Cell-O" machines for milling, polishing and grinding jet propeller blades and "Micrometric" honing machines. Many recent developments have been incorporated in the grinding machines and one model of completely new design is the universal toolroom machine, shown in Fig. 11.

This new machine can be used for external, internal and surface grinding and, when equipped with a universal cutter head, will also cover a wide range of tool and cutter grinding. It takes work up to 8in diameter and 24in long, and the table traverse can be operated by power, or by hand. Eight rates of power traverse, from 3¼in to 59in per minute, are available, the changes being obtained through a four-speed gearbox and a two-step vee-belt pulley. The upper table can be swivelled 7 deg. on each side of the centre line for taper grinding purposes, as well as 90 deg. each side of zero, a centre vernier scale being fitted for work which involves the wide angular setting. .

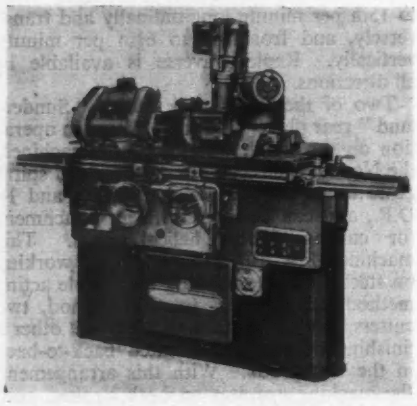


Fig. 11—Universal Toolroom Grinder—Jones and Shipman

The wheelhead column is mounted on roller slides to give accurate and sensitive control of vertical feed over the 8½in of movement. The wheelhead, which can be swivelled through a full circle, is fitted with a large protractor and vernier for accurate angular setting purposes. A 1 h.p. motor mounted on the upper part of the wheelhead drives the spindle by belt through pick-off pulleys, giving a range of external grinding wheel speeds of 5300, 4000 and 3250 r.p.m. Both ends of the wheel spindle are tapered to receive wheel flanges, the left-hand carrying a 7in diameter wheel for cylindrical or surface grinding, and the right-hand end for carrying disc cup or dished wheels for cutter grinding purposes. The spindle unit is offset from the swivel centre, and, with the wheel spindle arranged at 90 deg. to the table, surface grinding capacity is available over the full width of the table without the use of an extension spindle. A self-contained internal grinding unit with its own ball bearing-mounted countershaft, is driven from the wheelhead motor by the same belt as the wheelhead unit.

A typical example of the firm's "1001" range of hydraulically operated precision grinding machines is illustrated on Plate 4. These machines are made with varying swing

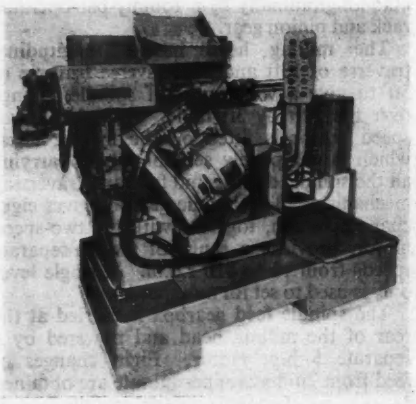


Fig. 12—Blade Profile Milling Machine—Jones and Shipman

capacities, from 8in to 14in, and between-centre lengths from 18in to 60in. The range includes simple machines with all controls centralised for easy hand operation and with simple means of automatic wheelhead advancement. Other machines in the range are of the automatic cycle design with fully coupled controls—hydraulic quick withdrawal of wheelhead, automatic resetting of feed for repetition operations, &c. In addition, other facilities such as micrometer longitudinal movement to the table for face grinding can be fitted as standard extra equipment, as well as a hydraulic tailstock with pedal control, and electronic speed control to the workhead spindle. The kneehole cabinet can be arranged with a built-in seat for the operator if required.

The group of "Ex-Cell-O" machines for the manufacture of gas turbine compressor blades shown on this firm's stand will include the profile milling machine illustrated in Fig. 12, the profile grinder, Fig. 13, and the profile polisher, Fig. 14.

The profile milling machine is designed to mill the complete airfoil form, including leading and trailing edges, of turbine blades and similar parts. The machine is hydraulically operated and is fully automatic except for loading and unloading the work.

The airfoil form of the blade is generated by means of a master cam which is made directly from the master glass layout. The blade is located from the finished root form at one end and from a centre at the other end. Roller back rests steady the blade during the cutting

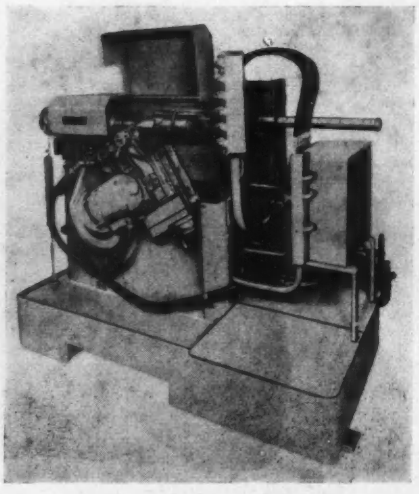


Fig. 13—Blade Profile Grinding Machine—Jones and Shipman

operation. The work travels across the milling cutter lengthwise so that the part is supported rigidly by the back rests throughout the stroke. The part is indexed after each stroke, the number of indexes and the space between each being determined by the spacing of pins in an index plate. At each stroke a developed end cam controls the lateral position of the blade root in relation to the cutter.

When the blank has been loaded and the start cycle button pressed the work spindle, tailstock and back rests are clamped hydraulically and the part is lowered to the cutting position at a controlled speed. Upon reaching a predetermined position the work is moved laterally across the cutter by an hydraulic cylinder, and is slowed down at each end of the stroke. The spindle, tailstock and back rests are unclamped automatically after each cut, then the part is indexed a predetermined amount for the next cut, and the spindle, tailstock and back rests are clamped again. This cutting and indexing cycle is repeated until the part has rotated 360 deg. At the end of the last cut the workhead rises to the loading position, and the machine comes to rest with the work spindle, tailstock and back rests unclamped.

In the profile grinder the blade is located in a similar way from the finished root form

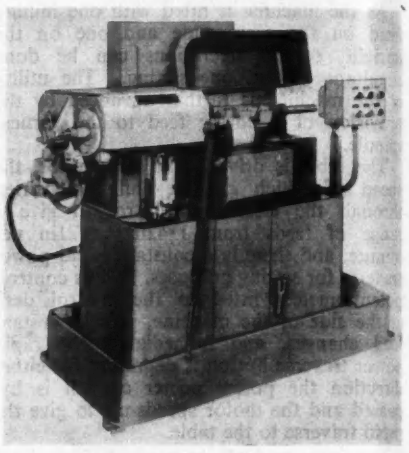


Fig. 14—Blade Profile Polishing Machine—Jones and Shipman

at one end and from a centre in the other end. The work is rotated and traversed across the grinding wheel. A two-speed work drive rotates the part at high speed when the grinding wheel engages the thin edges of the blade, where the area of contact between the wheel and the work is small. Whilst the wheel cuts the sides of the blade, where the area of contact is much larger, the work drive motor slows down. Thus the two different work speeds are each used twice during each revolution of the part, producing a uniformly fine work finish. The part is traversed hydraulically at an adjustable rate of feed.

The profile polishing machine is designed to polish the airfoil form on both sides of parts such as turbine blades to within $^{1}/_{4000}$in of the leading and trailing edges. The machine is fully automatic in operation except for loading and unloading the parts. The polishing is done by an abrasive belt which passes over three pulleys—a rubber pulley where the belt comes in contact with the work, an idler pulley, and a three-step drive pulley on the motor shaft.

A master cam controls the relationship of the work to the abrasive belt as the work rotates. A feed screw causes the work to travel laterally across the belt and return.

The machine is equipped with a balancing spring to give the desired pressure between the work and the belt, and its coolant pump has automatic controls to start and stop the coolant flow.

This company will also be showing a wide range of its well-known small tools and a group of the honing machines made by the Micromatic Hone Corporation, of Detroit, U.S.A., for which it acts as selling agent in this country.

George Richards, Ltd.

One of the machines of completely new design being shown by George Richards, Ltd., of Broadheath, Manchester, is the 4ft, high-speed, double standard, vertical boring and turning mill illustrated on Plate 2. It incorporates the firm's latest developments in this class of mill and the spindle bearings, lubrication and controls have been modified and improved to give high working speeds with ease of control.

The machine has a substantial cast iron base, strongly reinforced by internal ribbing, and it can be supplied with a four-jaw independent or a three-jaw self-centring table. It is driven by a 3 to 1 variable-speed d.c. motor, through a mechanically-operated three-speed gearbox, the final drive to the table being through spiral bevel gears and a single helical gear and pinion.

The mill has an infinitely variable speed range from 9·26 to 250·28 r.p.m., and gearbox speed changes are effected by a single speed selector lever, whilst speed variations to the motor are controlled from the desk in front of the machine. The two pendant push-button stations provided can be swung to any position convenient to the operator and they enable him to control the main and rapid traverse motions.

The feeds to each head are selected by levers on drive units at each end of the cross-slide, and sixteen independent and reversible rates of feed, from 0·001in to 0·102in per revolution are provided. Index dials, calibrated in 0·001in, provided on the inner sides of the feed boxes are easily read from the operating position. Fine hand adjustment to a head horizontally, or to its ram vertically, is provided through a handwheel, also mounted on the front of the feed box.

If required, the machine can be fitted with an electrically operated constant cutting speed control device which works in conjunction with the main driving motor. With this device the various constant cutting speeds are obtained through a selector on the control desk.

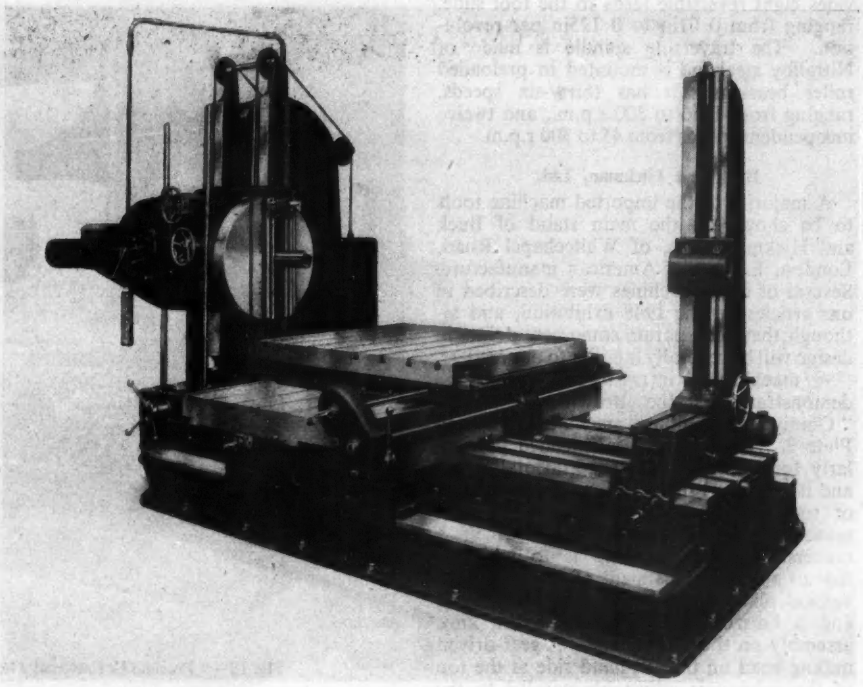


Fig. 16—" Electrabore " Horizontal Boring Machine—Richards

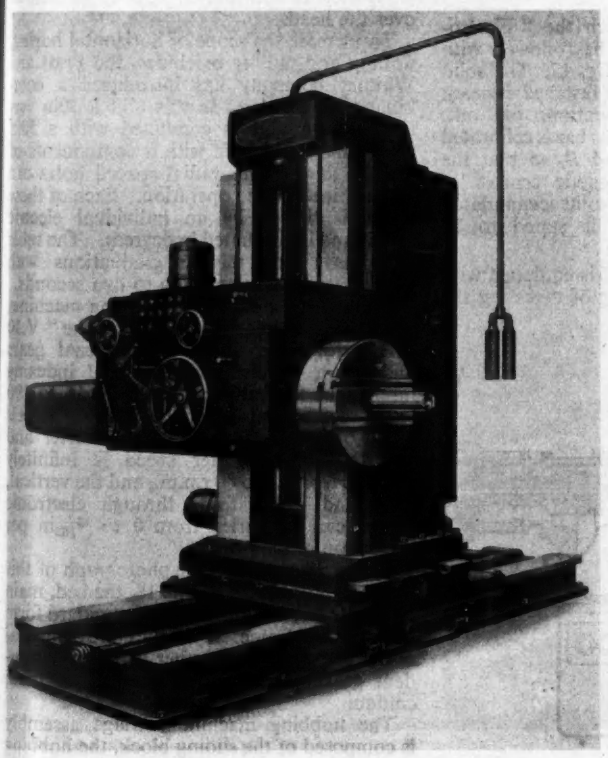


Fig. 15—Travelling Column Boring Machine—Richards

Two of the firm's " Hydrabore " horizontal boring, facing, milling, drilling and tapping machines will be exhibited: the travelling column model " No. 3," illustrated in Fig. 15, is of a new design. The machine has been introduced to meet the demand for a medium-size travelling column machine, which, whilst able to deal with very large workpieces, with bores at considerable distances apart, is of medium size as far as boring and facing capacity is concerned, and is therefore able to run at high speeds. In it the main driving motor is mounted directly on the new design of spindle frame, and all the gearing necessary to obtain the range of speeds provided is self-contained in the frame.

The upright has a traverse of 8ft along the 4ft wide bed and a hand-operated cross adjustment of 6in is also provided. Churchill " Hydrauto " bearings are fitted to the main spindle to ensure correct bearing pressures at all speeds and obviate the necessity for bearing adjustment at extremes of spindle speeds.

The 4in diameter traversing spindle of Nitralloy steel is mounted in preloaded roller bearings, and has eighteen speeds ranging from 5 to 500 r.p.m. Six independent traversing spindle speeds range from 100 to 500 r.p.m., and all speed changes to the spindle are made through a single lever on the frame.

The facing head, which is designed for work up to 42in diameter and has twelve speeds, ranging from 5 to 220 r.p.m., is bolted direct on to the main spindle flange. The totally enclosed mechanism in the head is of robust construction, and provides eight reversible feeds, ranging from 0·005in to 0·1in per revolution, to the flush-fitting tool slide.

Push buttons for controlling the main motor and rapid traverse motors are grouped in a convenient position on the spindle frame and are duplicated on an adjustable pendant switch. Dynamic braking of the main motor ensures that the head can be stopped in any required position even when using heavy out-of-balance tooling.

The " Electrabore " horizontal boring, facing, milling, drilling and tapping machine illustrated in Fig. 16 has a traversing spindle 5in diameter and a facing head for work up to 54in diameter. The 10ft wide bed of this machine is sufficiently long to admit up to 12ft between the facing slide and boring stay. It is provided with an 11ft by 6ft main table and its 6ft square revolving table is fitted with a squaring lock, by means of which the table can be set square with the spindle with complete accuracy. Eight rates of feed from 0·005in to 0·063in are provided for the tables longitudinally and transversely, for the spindle frame vertically and traversing the spindle longitudinally.

The large-diameter main spindle is driven through chains and is carried in phosphor-bronze bearings set well apart to ensure rigidity when using heavy tooling. The facing head, which has twenty-four speeds, ranging from 1·66 to 130 r.p.m., is bolted direct on to the main spindle flange. The totally enclosed mechanism in the head pro-

vides eight reversible feeds to the tool slide, ranging from 0·01in to 0·125in per revolution. The traversing spindle is made of Nitralloy steel and is mounted in preloaded roller bearings. It has thirty-six speeds, ranging from 1·66 to 300 r.p.m., and twelve independent speeds from 45 to 300 r.p.m.

Buck and Hickman, Ltd.

A majority of the imported machine tools to be shown on the main stand of Buck and Hickman, Ltd., of Whitechapel Road, London, E.1, are of American manufacture. Several of these machines were described in our articles on the 1948 exhibition, and although they incorporate some new points in design will be generally familiar to our readers.

A machine of interesting design to be demonstrated is the Brown and Sharpe "Omniversal" milling machine, shown on Plate 3. This machine is intended particularly for toolroom and experimental work, and it can be arranged for an extensive range of set-ups. In addition to all the usual movements and adjustments of which a universal milling machine is capable, it has an angular adjustment of the table in a vertical plane at right angles to the spindle, and a horizontal feed of the entire knee assembly on the same plane. A gear-driven milling head on the left-hand side at the top of the column is adjustable parallel to the overarms, and is arranged for universal angular adjustment with a 2in hand feed to the spindle. The makers point out that the machine provides an easy and accurate means of obtaining both simple and compound angular settings in any plane. On it work can be milled on a number of planes, or drilled, bored or reamed at many different angles, without the use of special fixtures, and often without need for relocating the work.

The table and the knee slide each have a longitudinal feed of 17in to give a combined feed of 34in in the horizontal position. The transverse feed is 6in and the vertical adjustment is 15in. A 2 h.p. motor at the rear drives the spindle through gears giving eighteen speeds from 40 to 1530 r.p.m., and the milling head spindle, which is driven through gearing from the rear of the main spindle, has eighteen speeds from 72 to 2900 r.p.m.

A jig borer of particularly large capacity is the Pratt and Whitney "No. 4 E" machine, (Plate 2) which is relatively new to this country. This machine, with a table 72in long by 36in wide, is designed to handle work weighing up to 5000 lb and the maximum setting distance between the table top and the spindle end is 47in. All motions are controlled electrically through push buttons and these buttons, together with speed and feed selectors, are grouped in an adjustable remote control station. It has an infinitely variable range of milling feeds from 1in to 15in per minute for the table and carriage, with rapid power traverse of 60in per minute for quick positioning purposes. The head has a travel of 17in on the column and the spindle quill travel is 10in. The spindle has twelve speeds, from 30 to 1500 r.p.m., with eight feeds from 0·0005in to 0·015in per revolution.

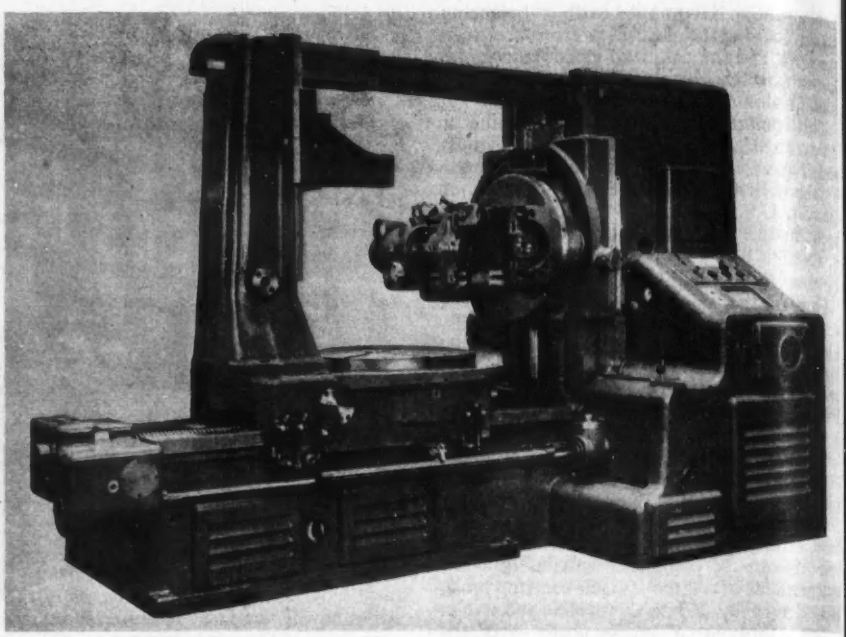


Fig. 18—"Precimo" Universal Gear Cutting Machine—Buck and Hickman

In the new Pratt and Whitney "Electrolimit" measuring system, which is fitted on this machine, a basic 1in spacing is obtained from a solid master bar and these 1in spacings are determined by electrical means and registered on an indicating meter. There are two of these units concealed and protected within the machine, one for the longitudinal motion and one for the carriage transverse motion.

The principle upon which the "Electrolimit" system works can be followed with reference to the diagram Fig. 17. The solid master bar *A*, permanently fastened beneath the machine table, has sections cut out, leaving ½in wide blocks. This bar is calibrated to the electromagnetic head *B*, so that the distance between the magnetic centres of adjacent blocks is 1in. The total accumulated error for bar calibration is stated to be 0·00002in.

The electromagnetic head is equipped with two balanced coils, capable of detecting the exact magnetic centre of each block. When one of the blocks is exactly over the head, the indicating meter *C* will register zero. Thus, the master bar provides means to locate distances in exactly 1in spacings.

It will be noted that the head is mounted on a movable slide *D*, which can be adjusted by either the zero screw *E* or the precision micrometer screw *F*. The zero screw provides means to centre the electromagnetic head under the nearest block without moving the table, giving a zero reading on the indicating meter. Settings in fractions of an inch are made with the precision micrometer screw, which only moves the electromagnetic head to a position between two blocks on the master bar. The table is then moved with handwheel *G* until the block is again centred over the head.

To increase the scope of horizontal boring, drilling and milling machines, the Pratt and Whitney company has introduced a combination table unit. In this unit a 30in vertical rotary table is combined with a 50in plain rotary table and with it components of various angles with radial spaced holes can be machined in one operation. Each of these tables is driven by an individual electric motor and is graduated in degrees. The table dials have one minute graduations with vernier graduations reading to two seconds.

Three "Precimo" gear hobbing machines are to be exhibited and the largest (the "V.10 L.E.") for spur, spiral and internal gears and worm wheels has differential indexing mechanism for cutting gears from 15 to 190 teeth. Its normal capacity is for spur wheels and worm wheels up to 60in diameter and 1·5 D.P. The cutter speed is infinitely variable from 24 to 80 r.p.m., and the vertical, axial and radial feeds through electronic means can be varied from 0 to $^{12}/_{32}$in per revolution of the work.

As can be seen from the photograph of this machine reproduced in Fig. 18, the bed, main column, cross bar and auxiliary standard form a rigid closed frame. All of the control mechanisms are grouped together in two independent gearboxes on either side of the main column.

The hobbing machine carriage assembly is composed of the sliding block, the hobbing head and the cutter spindle. This assembly

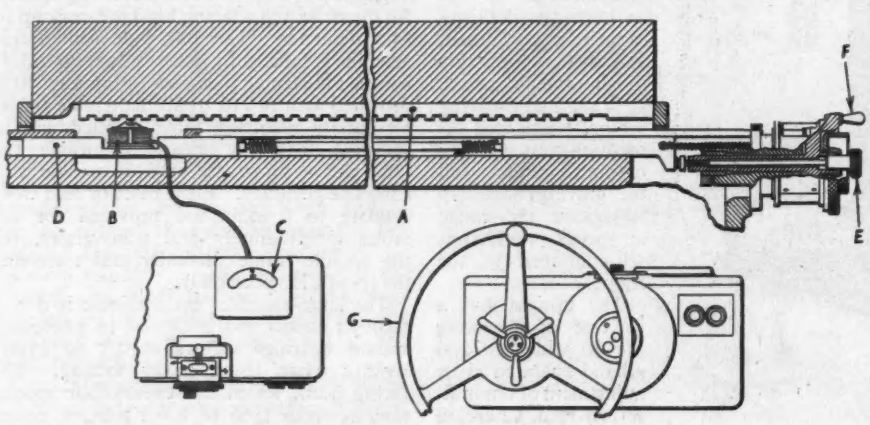
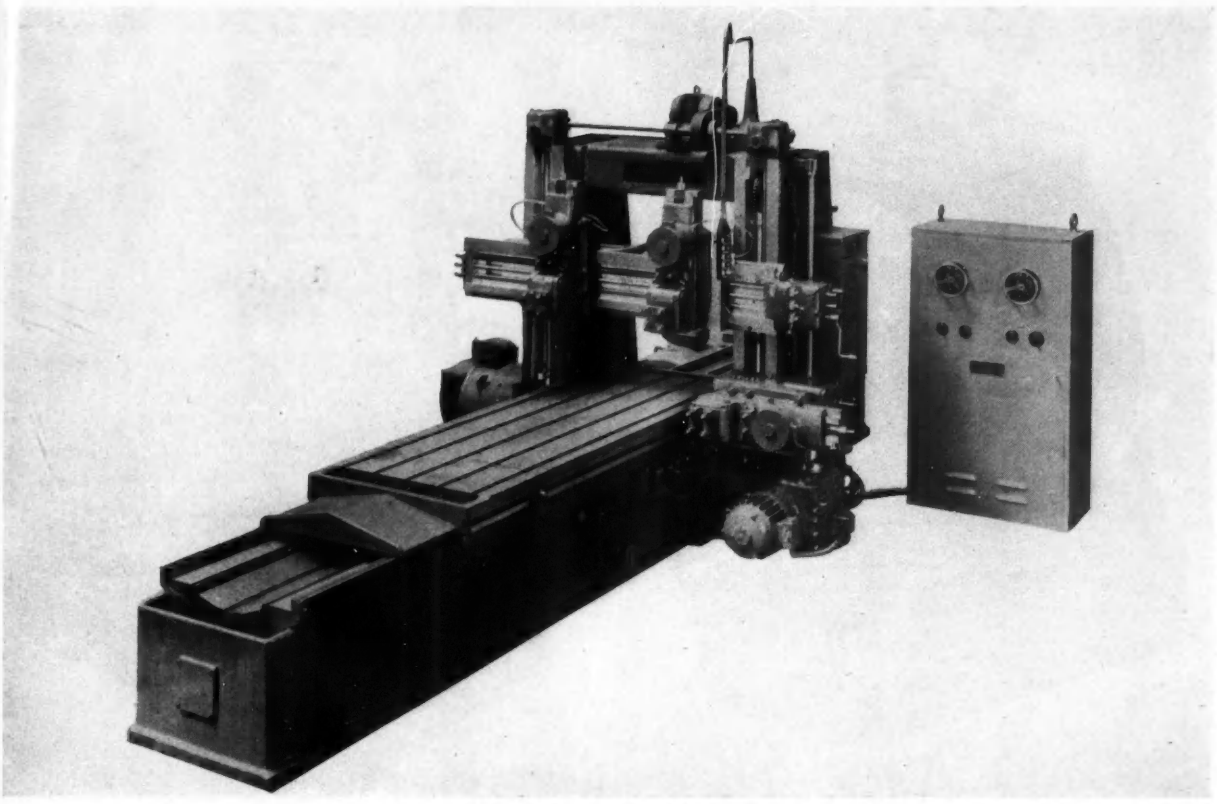
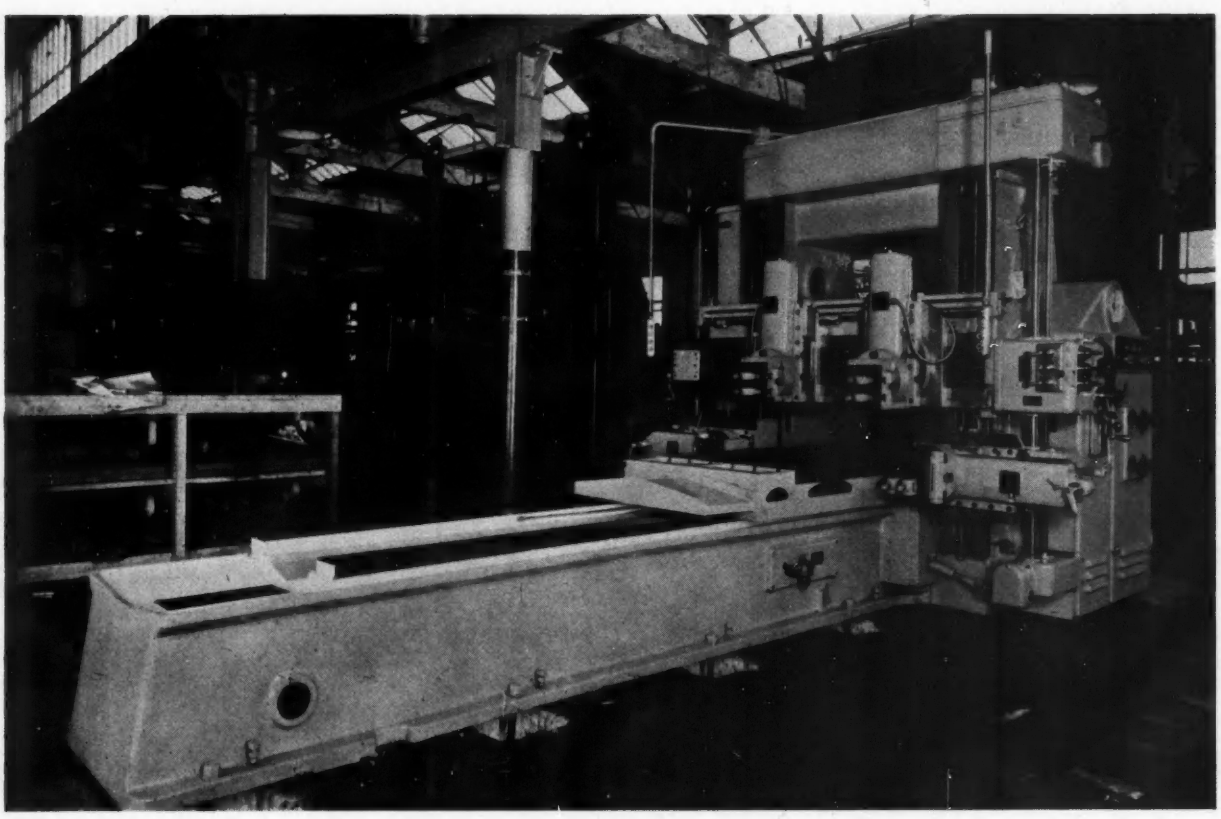


Fig. 17—Measuring Unit for Longitudinal Motion—Buck and Hickman

PLANING MACHINES AT OLYMPIA

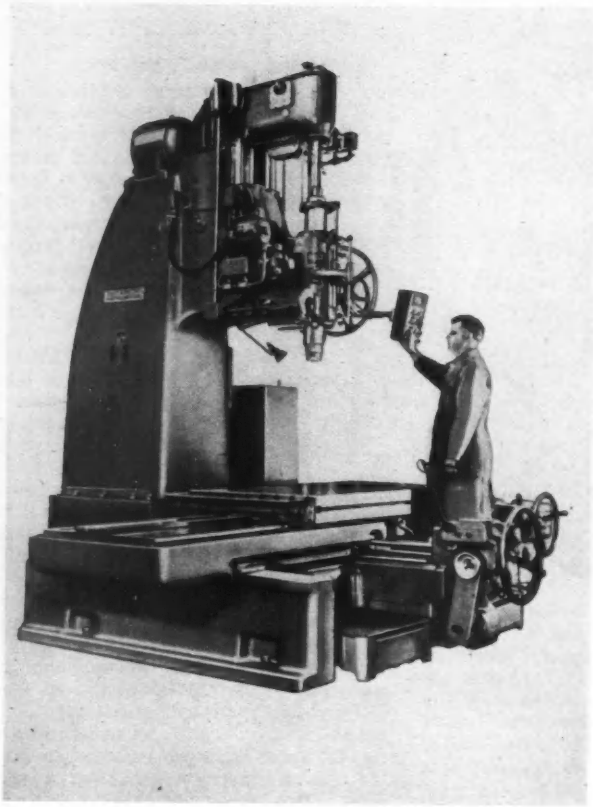


All - Electric Planing Machine—Swift

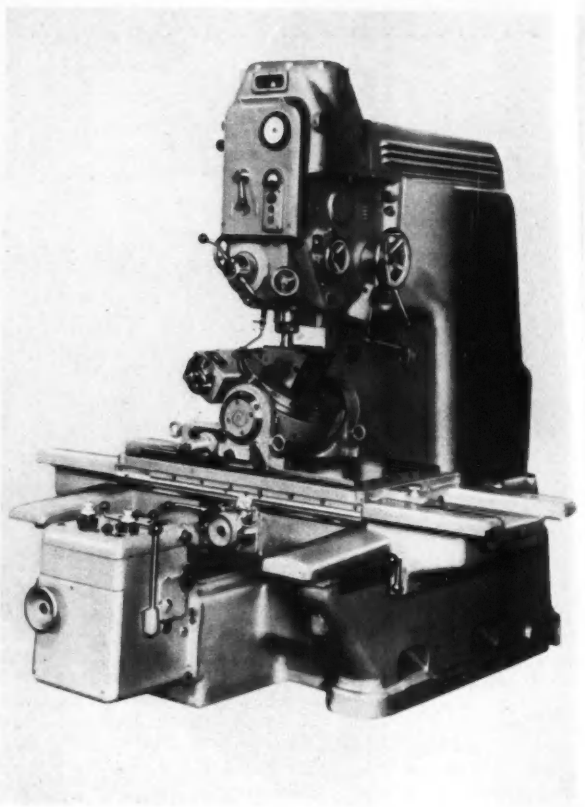


All-Electric Planing Machine—Stirk

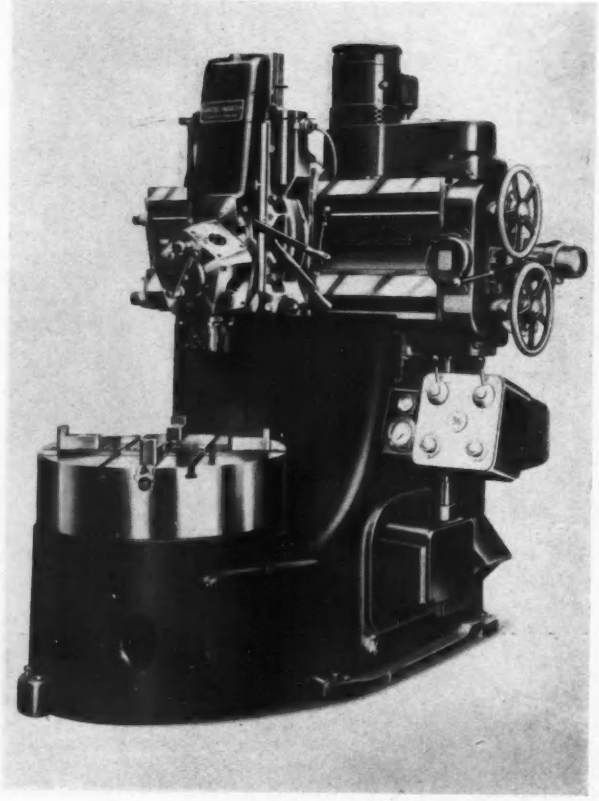
JIG BORING AND VERTICAL BORING MACHINES AT OLYMPI[illegible]



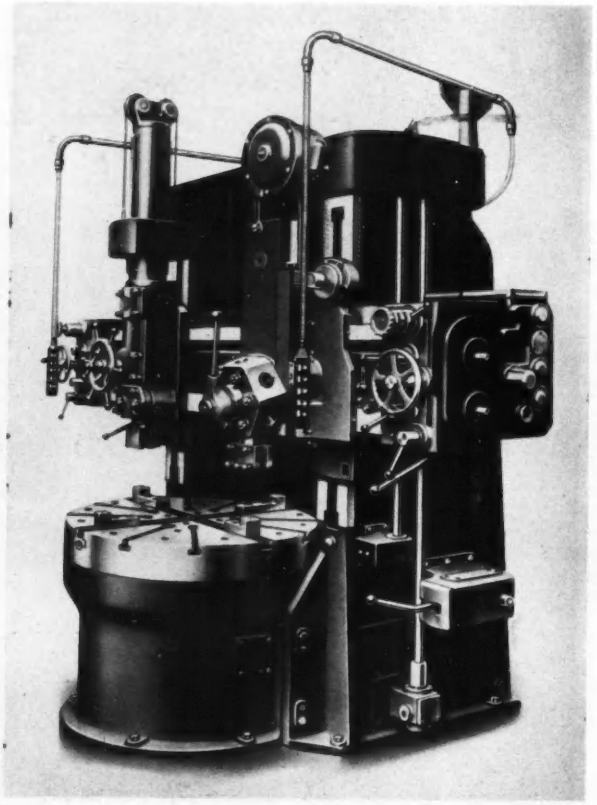
Large Jig Borer—Buck and Hickman



Lindner Jig Boring Machine—Stedall

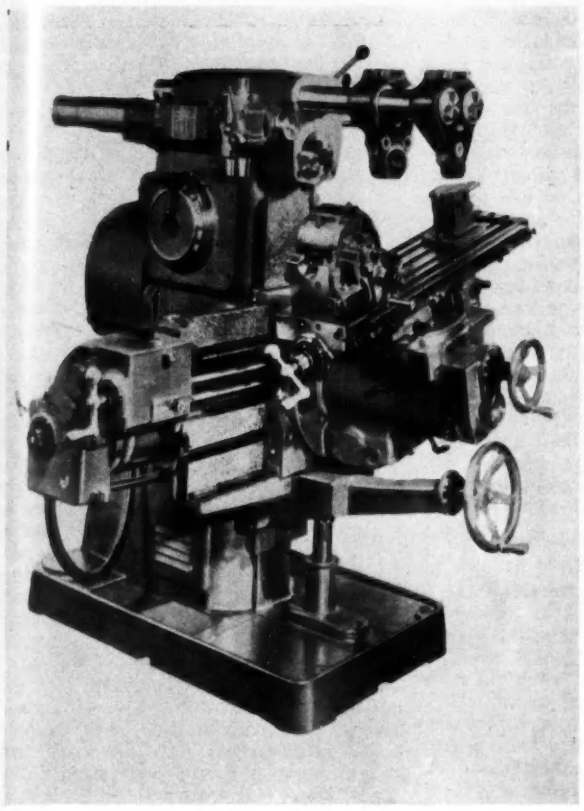


36in Boring and Turning Mill—Webster and Bennett

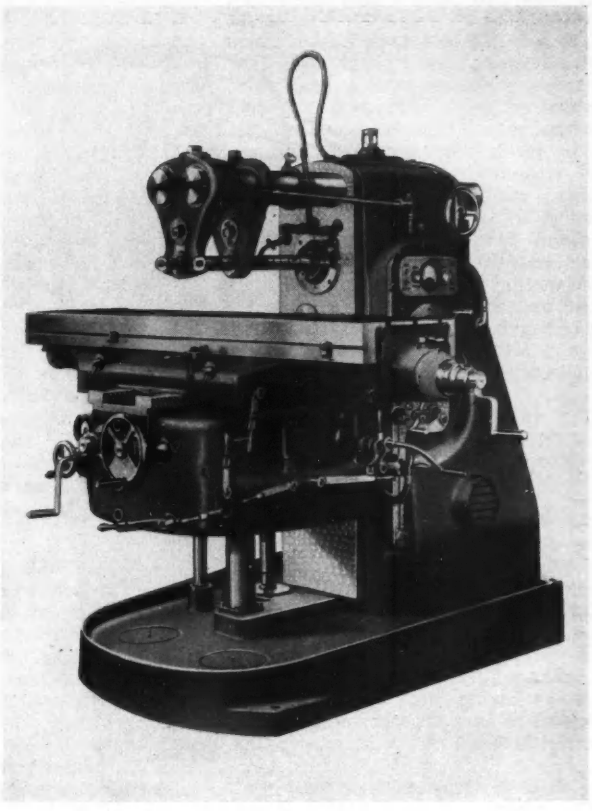


4ft Double Standard Vertical Boring Machine—Richards

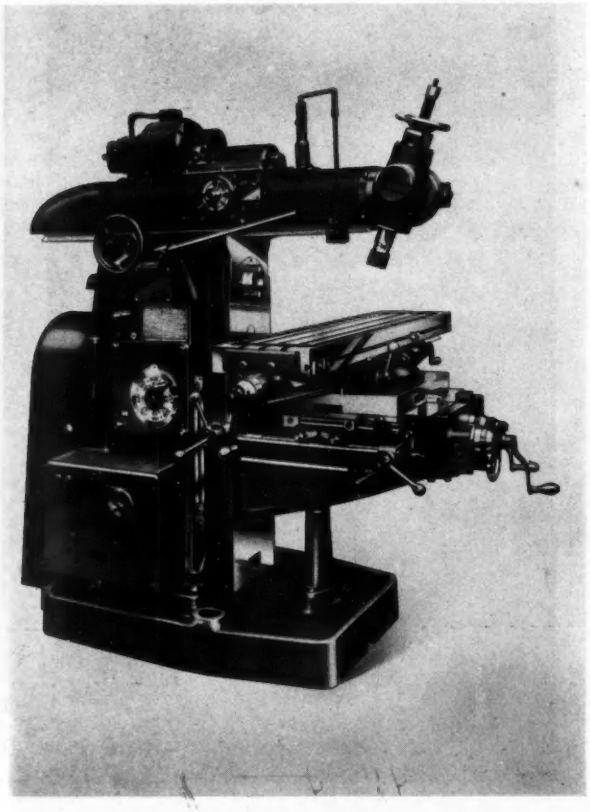
MILLING MACHINES AT OLYMPIA



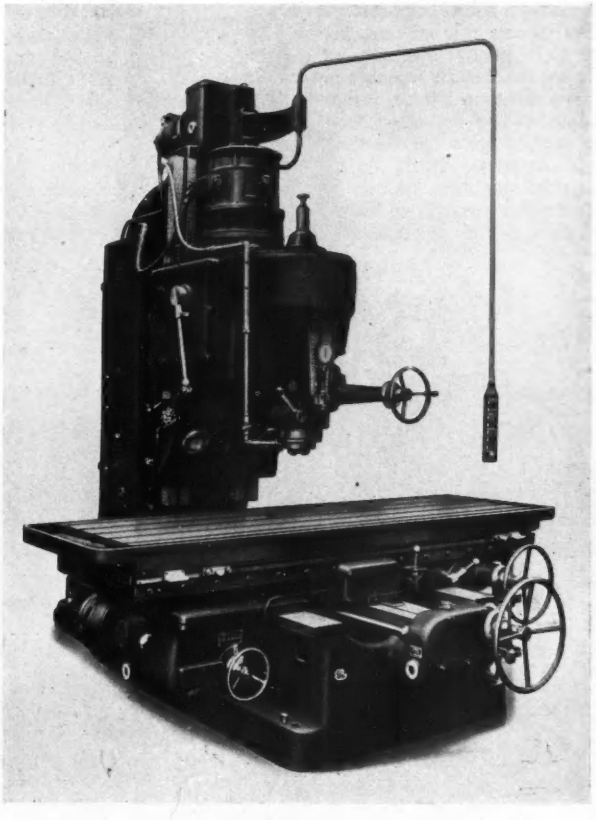
"Omniversal" Milling Machine—Buck and Hickman



All-Geared Horizontal Milling Machine—Adcock and Shipley

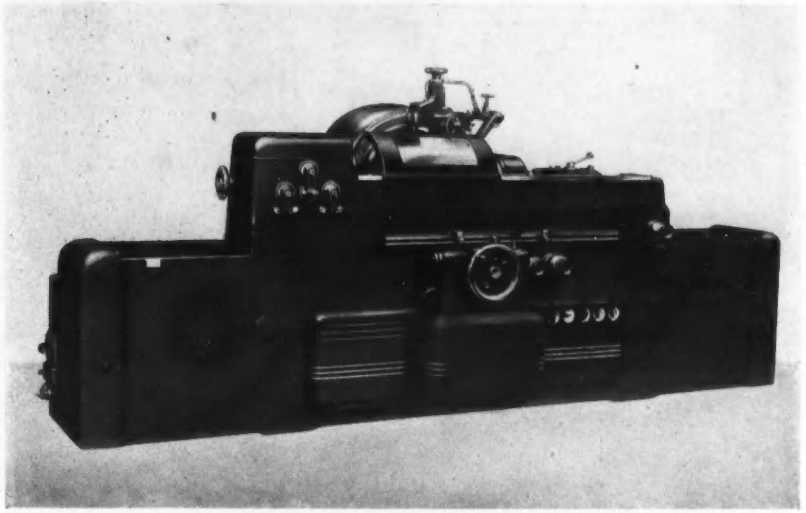


Miller with Universal Attachment—Parkinson

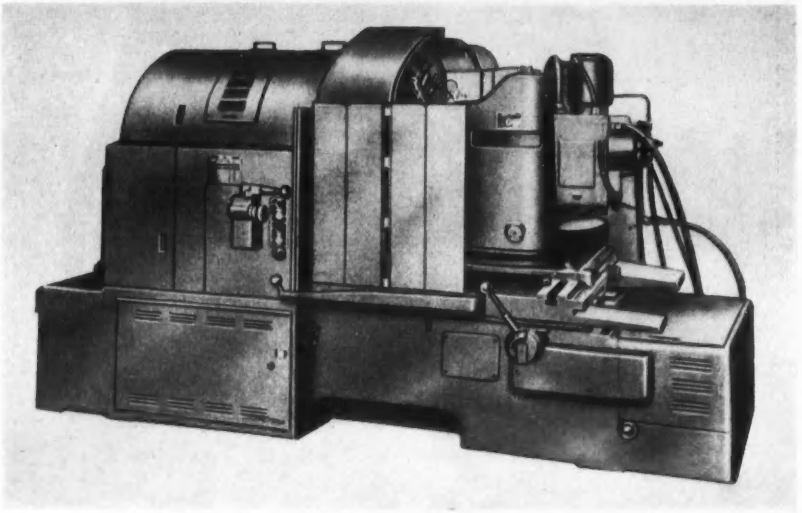


Heavy-Duty Vertical Milling Machine—Kendall and Gent

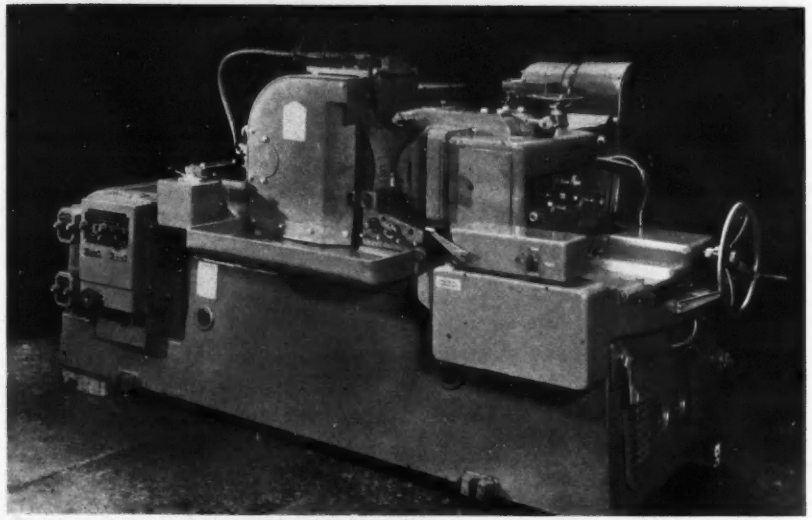
GRINDING MACHINES AT OLYMPIA



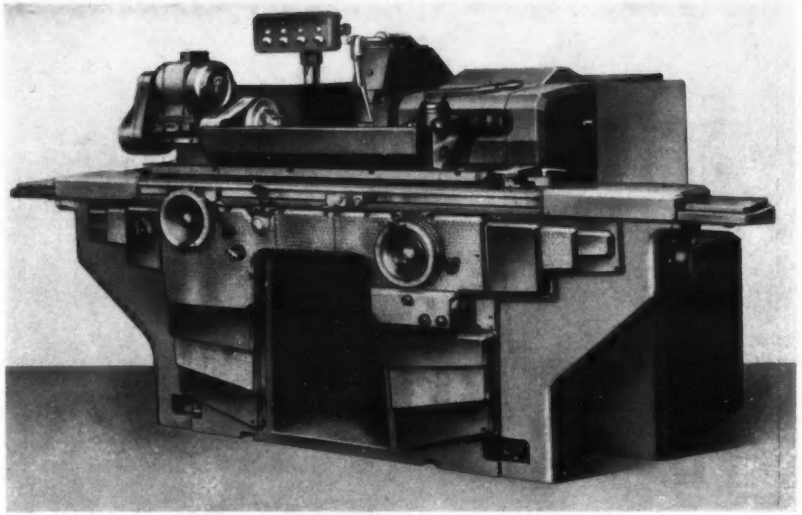
Universal Thread Grinder—Coventry Gauge



Coupling Grinder—Gleason



Controlled Cycle Centreless Grinder—Scrivener



Hydraulic Precision Grinding Machine—Jones and Shipman

weighs about 1 ton and a counterweight, fixed by chains to the carriage, balances the vertical motion of the carriage. The sliding block moves in the double rectangular slides of the upright and its alignment is controlled by independent wedge-shaped components, adjustable in tension and compression. Centred on this block is the hobbing head, which can be set at all angles, in both directions, to permit the cutting of spiral gears.

The cutter spindle is controlled by a worm wheel driven by two worms,one on each side, and steadiness is imparted to the drive by a flywheel situated near the cutter.

A central screw moves the sliding block up and down and in order to eliminate backlash, particularly when down cutting, a special arrangement of two nuts is mounted on the screw. These nuts are adjustable with respect to each other, and one is always in contact with an opposed side of the screw, which is thus kept under tension.

The indexing mechanism consists of a tangent wheel driven by two precision-ground worms arranged at right angles, and engaging opposite sides of the wheel. Fixed directly over this wheel is the work table, and the whole assembly is mounted on a rigid carriage which traverses the machine bed.

A differential mechanism, used when cutting spiral pinions, is situated between the table control and vertical feed control. It produces a continuous complementary rotary movement of the table which is proportional to the downward feed of the cutter. An axial feed head, used when cutting worm wheels, is an independent unit which is fixed to the machine instead of the normal cutting head. An independent motor-driven automatic indexing mechanism is fitted to the top of the gearbox when it is required to cut spur and spiral teeth by a side cutter using the normal milling head.

In addition to these machines there will be exhibited three Bryant grinders, a Bullard " Man-au-trol " vertical turret lathe, a Rhodes hydraulic press and shearing machine, Brown and Sharpe grinding machines, &c.

Index Automatic Machines, Ltd.

A high-speed automatic made by the Index Automatic Machine Company, Ltd., of Redditch, Worcs, will be exhibited on the stand of Burton Griffiths and Co., Ltd., and is illustrated in Fig. 19. This machine, the " ON.12 " model, has a chuck taking ½in round or $\frac{7}{16}$in hexagon bar with a maximum feed of $1\frac{3}{16}$in on one indexing. The machine is driven by a 3 h.p., 1430 r.p.m. motor driving through a countershaft in the base, the ten work spindle speeds available ranging from 750 to 6000 r.p.m.

Index machines have swinging tool equipment and screw threading is carried out by a threading spindle which overtakes the work spindle and rotates in the same direction. Threading and cutting operations by the swing tools can be arranged to take place simultaneously, and, if required, the threading spindle can be substituted by a high-speed drilling or a drill and turning attachment. The four swinging side tools—for turning, forming, cutting off, centring and drilling—are carried on rigid shafts, and their holders with the swing stops are operated through cams, reverse and gear segments arranged around the work spindle.

The camshaft is easily accessible at the front of the machine and has the block carrying the cams for operating the swinging side tools on the left-hand side. This block can be removed as a complete unit when changing cams. A drum cam connected to the shaft controls bar feed and chucking.

Stedall Machine Tool Company, Ltd.

The equipment made by Herbert Lindner G.m.b.H., of Berlin, to be shown by the Stedall Machine Tool Company, Ltd., 145, St. John Street, London, E.C.1, includes a thread grinder and a jig boring machine.

The thread grinder, illustrated in Fig. 20, is intended particularly for production work and is fitted with a relieving attachment for use when handling hobbing and form cutters. It takes work up to 32in long between centres and has a grinding capacity of 8in diameter by 20in long, or 10in diameter by 4in long. The table way of this machine can be swivelled so that the work table carrying the headstock and the tailstock can be tilted in relation to the grinding wheel to facilitate rapid in-feed and withdrawal of the work relatively to the grinding wheel.

When adjusting the helix angle the table is swivelled by a pinion and toothed segment with reference to a scale and a fine adjustment is provided for setting up a precut thread in relationship to the wheel. Dial calculators built into the workhead can be used to ascertain helix angles and feeds without need for calculations on the part of the operator.

The workhead is driven through an infinitely variable speed gear unit, and the leadscrew of the machine through change gears. A single lever which actuates relays can be used for controlling movements of the work, feed, lead, relief and coolant supply, and at the end of a grinding cycle the mechanisms are automatically disengaged.

The No. 15 jig boring machine exhibited (Plate 2) has a direct measuring system which is read by optical means for fine settings, in addition to coarse scales for the longitudinal and transverse movements of the table. In this fine setting system cylinders with a high surface finish have the graduation inscribed in the form of a fine helical line forming a continuous thread round their circumferences. These cylinders can be rotated and are connected to the co-ordinate slides so that as the scale is rotated the intermediate measurements from thread to thread can be set on an annular scale to a stated accuracy of 0·001mm. The scale is read through a microscope.

The boring spindle has an infinitely variable range of speeds from 50 to 1900 r.p.m. and feeds from 0·03mm to 0·16mm per revolution in each direction.

Wilkins and Mitchell, Ltd.

As a result of long experience with its stripping presses in drop forging work, Wilkins and Mitchell, Ltd., of Darlaston, S. Staffs, was prompted to design and construct a press specially for forging, and for the first time one of the new presses is being exhibited at Olympia. This machine has a capacity of 1200 tons and will be one of a planned group of eight sizes of from 600 to 3000 tons capacity in the new " Forgemaster " range.

The new machine, which is to be seen in course of erection at the makers' works in Fig. 21, has a frame fabricated from heavy rolled steel plate so arranged that there are no load-carrying joints. The front and back uprights of the machine are spaced apart by deep cross plates and welded together to form a single rigid structure with an aperture in the uprights for the tool space. The drive is transmitted through vee belts from a totally enclosed motor to the grooved rim of the flywheel, which idles on ball journals. The drive is engaged by a multi-plate, direct-acting friction clutch operated by compressed air, and an automatic spring-loaded brake is applied on clutch withdrawal.

The clutch shaft is forged with integral

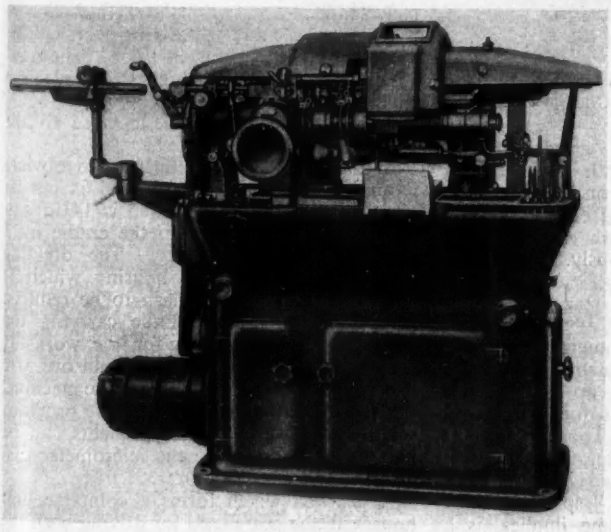


Fig. 19—High Speed Automatic—Burton, Griffiths

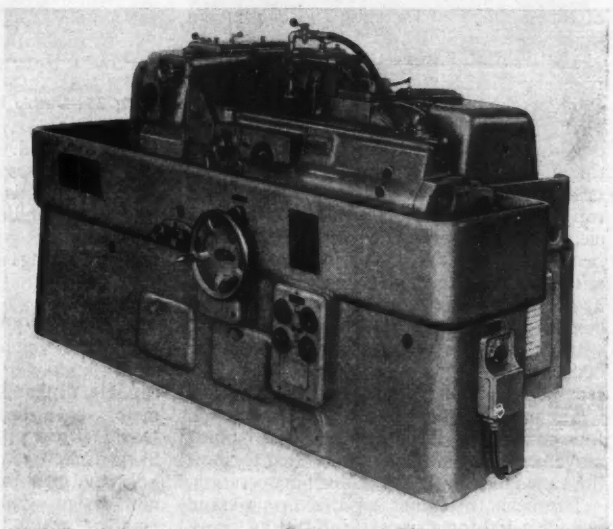


Fig. 20—Lindner Thread Grinding Machine—Stedall

twin drive pinions giving a direct drive to two pairs of bull wheels, each pair of which is secured to the faces of a forged steel eccentric journalled on a bronze-lined steel connecting-rod. Each eccentric is keyed to a large-diameter forged steel mandrel journalled in the press frame. These mandrels are arranged side by side with their axes running back to front of the frame, and the design is such that forging pressure is equally distributed to the two connecting-rods and ensures uniformity of tool loading.

The deep fabricated slide has long narrow vee alignment ways with bronze linings having a large surface area. This slide is built into apertures in the frame side members, which are sealed by rigid steel castings, embodying adjustable gibs. Thrust is transmitted to the slide by forged steel mandrels journalled in bronze bushes. As the tools used are always set within these two points

Fig. 21—1200-ton Forging Press—Wilkins and Mitchell

of thrust tilting of the slide and consequent rapid wear is avoided.

The weight of the slide and reciprocating parts is balanced by two compressed air cylinders arranged on each side of the base of the machine. The reaction of these cylinders takes up backlash and all working tolerances in the mechanism, and eliminates bearing hammer. Positive and automatic top and bottom ejectors are fitted. The top ejector consists of a hardened faced slipper bearing on knock-out pins in the slide face and is actuated through a link pivoted in the head of a connecting-rod. The bottom ejector incorporates hardened face slippers which thrust the pins upwards through the bed, and it is controlled by a cam which is secured to one of the bull wheel mandrels.

The machine has means of both hand and foot controls, giving continuous and inching movements. A strain gauge is fitted to show the tonnage being exerted during operation.

The other machines on this firm's stand include a 100-ton stripping and setting press, a hot brass stamping press of 100 tons and a 150-ton blanking and drawing press.

Jackman Machine Tool Company, Ltd.

Five sizes of disc grinding machines exhibited by George Jackman Machine Tool Company, Ltd., 29, Derby Road, Enfield, Middlesex, include two machines shown for the first time. One of these machines (Fig. 22) is a 6ft diameter horizontal disc grinder—the largest machine made by the

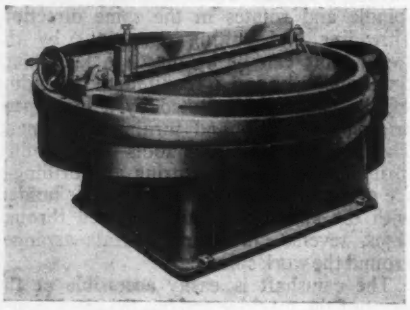


Fig. 22—Horizontal Disc Grinder—Jackman

firm. In this machine the spindle, which has a large flange supporting and driving the disc, runs on large roller bearings and is mounted as a unit in a rigid housing assembled in a heavy base casting. A totally enclosed motor of 20 h.p to 30 h.p. drives the spindle through vee-belts. The grinding disc, of ½in thick corrugated abrasive, is made in four sections, held in position by screws.

The double-ended disc grinder, shown in Fig. 23, is fitted with 30in diameter grinding discs, which are driven at up to 1350 r.p.m. A work table serving each of the discs has a wide range of movement in all directions, and once set can be rigidly clamped to give adequate support to the components

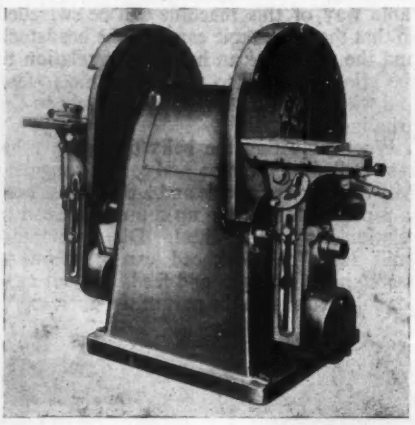


Fig. 23—Double Ended Disc Grinder—Jackman

being handled. Inserted grinding discs, corrugated discs or thin cloth abrasive discs can be fitted as required on this machine. A duplex grinding machine on the stand is arranged for grinding both ends of compression springs simultaneously.

David Brown Machine Tools, Ltd.

Five hobbing machines, ranging in capacity from 15in to 60in, and a gear shaving machine capable of handling gears up to 25in diameter, have been selected for display by David Brown Machine Tools, Ltd., of Sherborne Street, Manchester, 3. One of the hobbing machines exhibited is of entirely new design—the "M.T.-V." spline hobbing machine which, as its name implies, is a logical development of the company's existing "M.T. 15" hobber. By adaptation of the "M.T. 15," the makers have devised a machine which, though primarily designed to cut spline shafts up to 35in in length, is also capable of hobbing spur and helical gears up to 15in diameter.

On the new machine, contrary to normal practice, splines are cut in the vertical position, this arrangement being made possible by the mounting of a tall, rigid upright section to receive and hold the work. As can be seen in Fig. 24, the machine is arranged on a compact bed, by which a considerable saving of floor space is effected.

The machine has a rigid box-section bed, with carefully designed passages for the rapid removal of swarf and a large capacity sump for cutting fluid. Its upright is supported on a large facing spanning the full width of the bed, and the hob slide balance weight is housed in the casting cavity. Accurately ground ways on the upright carry the hob

Fig. 24—Spline Hobbing Machine—David Brown

slide saddle. The swivel slide, which houses the hob spindle and the driving gears can be swivelled through a full 360 deg. The non-rotating lead screw, through which the hob slide is traversed, is attached rigidly to the underside of the block slide as close to the hob as is possible.

In the course of manufacture to obviate mounting errors the wormwheel is cut in position with the table, which is 14½in diameter, and is supported in the cradle by a large flat annular seating. The dividing worm is mounted in a housing which is adjustable to allow backlash to be reduced to a minimum. The cradle carrying the table provides a mounting for the workstay which at its top is supported by an overarm brace mounted on the upright of the machine. Slideways of ample proportions are provided on the cradle and fine adjustments can be made with reference to the micrometer dial attached to the in-feed screw.

A gearbox which forms a complete unit houses all the gears used for driving both the hob and the table and it is enclosed within the bed of the machine. A 3 h.p. flange-

mounted motor at the rear of the machine provides the main drive, which operates speed and the indexing and feed change gears, all of which are easily accessible through openings in the bed.

Two of the "MT.15" gear and spline hobbing machines to be shown on the stand are built to generate spur and helical gears from 5in to 15in diameter and 10in face width. The universal model of these machines also generates wormwheels by the tangential feed method, and the machines can also be used for cutting splines of moderate length. Both machines shown are of improved design, the most noteworthy changes being the addition of an overarm support for the work-steady bracket and a redesigned hob slide giving greater strength and allowing for the use of larger hobs.

The largest machine displayed by the firm is an "MT.60," capable of hobbing spur, helical, spiral and worm gears up to 60in diameter and 22in face width. This machine is available with either a standard or traversing hob slide, and on it conventional or climb hobbing can be carried out without adjustment.

The gear-shaving machine, which is illustrated in Fig. 25, is designed for rapid shaving of spur and single helical gears up to 25in diameter by the radial loading method, and is fitted with an automatic crowning and chamfering device. This machine is built in three sizes for gears up to 5in, 10in and 25in diameter, and its construction is basically similar to that of the firm's hobbing machines, the axis of the work spindle in all cases being vertical. The main bed houses the work spindle at the forward end and carries the cutter head in horizontal flat guideways at the rear end. The work spindle is driven through a change speed gearbox by a constant speed motor, and is the driving member, the cutter being fed into engagement with, and rotated by, the work gear. The direction of cutter feed is vertical along an axis inclined to the axis of the work spindle and the cutter can be automatically or hand fed into mesh with the gear.

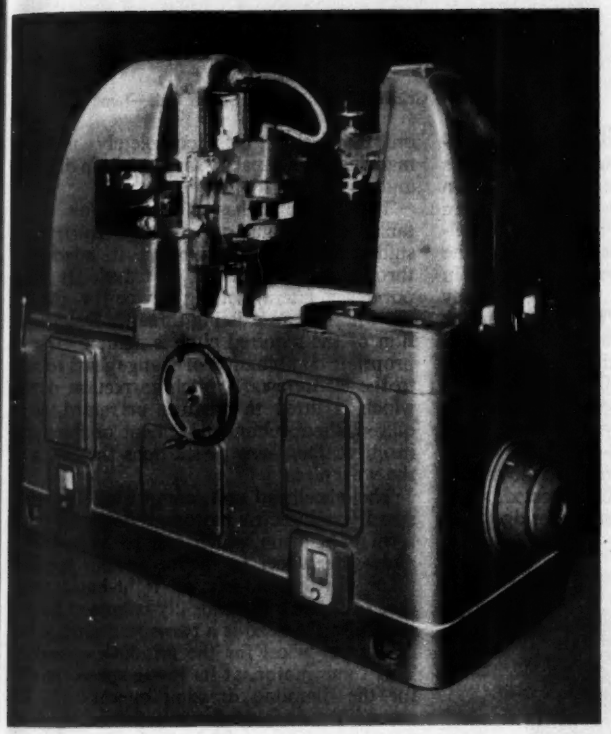


Fig. 25—Gear Shaving Machine—David Brown

The swivel slide in which the cutter spindle is mounted can be adjusted by means of a fine-pitch worm and wheel, a scale and vernier enabling accurate angular settings to be obtained. Slight alterations to the angular setting of the cutter to correct helix angle error can be made with the aid of a dial indicator attached to the cutter slide. Sine pins are fitted, over which micrometer measurements can be made for repeat settings.

The automatic crowning and chamfering device is part of the cutter slide assembly, and consists of a hinged slide, by means of which the cutter is fed radially into mesh with the work gear during the traverse of the cutter across the gear teeth. Motion to the hinged slide is imparted by a cam lever which makes contact with adjustable wedge-shaped cams mounted along a vertical face on the cutter head.

Arthur Scrivener, Ltd.

Three different examples of its well-known range of centreless grinders have been selected by Arthur Scrivener, Ltd., Tyburn Road, Birmingham, for exhibition, together with a recently introduced surface grinder and a profile turning lathe tooled up for machining a typical camshaft for an internal combustion engine.

In the special purpose lathe, a group of tools corresponding to the number of cam faces to be cut are mounted in holders in the tool slide, as can be seen in Fig. 26. Each tool holder is spring loaded and has at its rear a roller bearing follower through which it is advanced and withdrawn relatively to the rotating workpiece under the control of a rotating master camshaft at the rear. As machining proceeds, the group of tools is traversed axially to cover the width of the cam faces by a hydromechanical feed unit which gives the tool slide an infinitely variable feed rate in either direction. A special form of knife tool is used to obviate any rocking of the toolbox and ensure that the correct form is traced out on the work.

The new surface grinder, to be seen in Fig. 27, carries a table with a working surface of 8in by 18in, and having a longitudinal traverse of 19in, which can be operated by hand or hydraulic power, and a cross traverse of 9½in. The wheelhead, which carries a 10in diameter wheel, 1in wide, running at 1740 r.p.m., has a power rise and fall movement, operated by a separate 1 h.p. motor for rapid setting purposes. It has a maximum travel of 12in, giving a clearance of 10in between the table top and the periphery of a new wheel. Power movement of the head is controlled by a small hand lever which gives a rapid setting rate of 7½in per minute, or a slow inching movement up to the stage where final fine setting can be carried out by a fine feed handwheel graduated in 0·0001 in. A diamond wheel truing device is part of the standard equipment of the machine.

A second surface grinder exhibited is a smaller machine with a table having a working surface of 6in by 18in. Its wheelhead has a vertical movement of 12in, and the height from the table to the bottom of the wheel is 10in.

The group of centreless grinders will include the firm's "No. 2" controlled cycle machine, with a 20in by 6in grinding wheel,

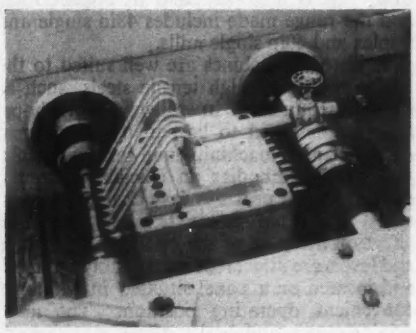


Fig. 26—Profile Lathe Tooling Set-up—Scrivener

which is shown in Plate 4. This machine is designed particularly for automatic or semi-automatic plunge-grinding of shouldered or form work, the control wheel and work being advanced on to the grinding wheel by the reciprocating movement of a hydraulically-operated cam plate. This cam plate has a suitable contour to provide for the preliminary quick approach of the wheel, a predetermined

Fig. 27—Surface Grinder—Scrivener

rate of stock removal, a final dwell, and a quick opening ready for the next cycle.

Also to be seen in operation on the stand and working in conjunction with a "No. 2 D.F." centreless grinder, is an example of the makers' latest design of rotary hopper. This hopper is used for feeding to a centreless grinder small cylindrical workpieces up to about ¼in diameter by 3in long, such as needle rollers, cycle chain pins, valve guides, small rollers, &c., to give very high production figures. The hopper consists essentially of a flat disc rotating at high speed within a shallow casing. The parts to be ground are thrown

on to this rotating disc, which aligns them by centrifugal force along the circular wall of the casing, whence they pass tangentially through a short feed tube to the grinding throat of the machine.

Webster and Bennett, Ltd.

The latest model of one of the 36in "D.H." series vertical boring and turning mills, made by Webster and Bennett, Ltd., of Coventry, is to be shown on the stand of Wickman, Ltd. It is a fine example of a piece of heavy equipment built on clean modern lines. This machine—to be seen on Plate 2—is the smallest in the range made by the firm. It is also supplied in duplex form and the range made includes 48in single and duplex and 60in single mills.

Whilst the machines are well suited to the heavy cutting of high tensile steels, such as those encountered in railway workshops, they are designed to be equally economical and efficient in machining non-ferrous metals.

The mill embodies an efficient hydraulic control, which provides easy change of feeds, speed and rapid power traverse with little effort on the part of the operator. All dials and levers are direct reading, suitably grouped, and located on a panel situated in the most convenient operating position. The main driving clutch and brake of the machine are both hydraulically-operated, and compensated for wear.

John Lund, Ltd.

A fine boring machine which is adaptable for a wide range of work will be seen amongst the exhibits of John Lund, Ltd., of Eastburn Works, Cross Hills, near Keighley. This machine, to be seen in Fig. 28, is double ended, with a rigid bed carrying a reciprocating table on long accurate guides. A bridge at each end of the bed provides a base for each of the independent spindle units, which can be fixed at any required point on their bridges to suit the size of work and fixture used. Workpieces can be mounted in any class of suitable fixture on the table or in chucks or fixtures on the flanges of the rotating spindles if required.

Each spindle unit is independently driven through belts by motors enclosed in the heads of the machine, and drives can be supplied from 1½ h.p. to 4½ h.p. according to the nature of the work. A 1½ h.p. motor-driven hydraulic pump unit in the base of the machine provides longitudinal traverse to the table. Through the control system table movements—rapid traverse, boring and slow facing feed—are selected by hydraulic valves, each actuated by a single pair of solenoids. These solenoids are energised by adjustable table dogs which depress snap action switches acting directly or through relays. Cycle selector switches provide slow or fast starting; slow, fast or no automatic reversing at the end of stroke; delay of spindle stop at end of table movement, and a setting cycle. In the case of a setting cycle, push-button and hand-lever switch controls supersede automatic operation. All movements are interlocked with each other and with the table positioning, and grouped controls facilitate operation of the machine.

The boring machine illustrated is tooled up for machining sewing machine motor end shields, but the machine to be seen at Olympia will be tooled up for turning differential casings, and its tailstock fixture carrying electrical push-button controls is mounted on the right-hand bridge.

Fig. 28—Fine Boring Machine—Lund

Coventry Gauge and Tool Company, Ltd.

The "Matrix" No. 46 thread grinding machine to be shown with a gear grinder and an optical jig borer upon the stand taken by the Coventry Gauge and Tool Company, Ltd., of Coventry, is illustrated on Plate 4. This completely universal machine has a capacity for work 10in diameter and up to 42in long.

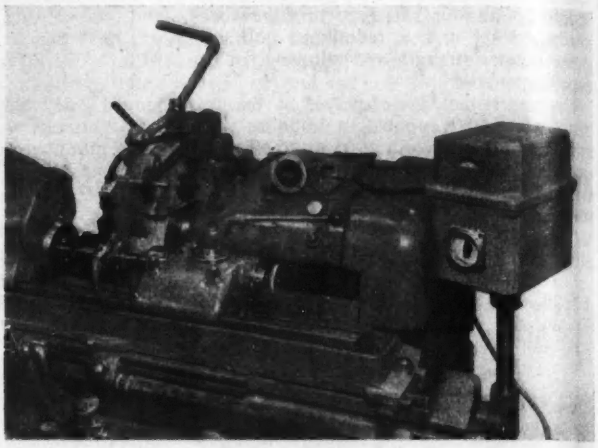


Fig. 29—Grinding Machine and Gauge Unit—Lund

One of the two plain cylindrical grinding machines to be exhibited is fitted with the firm's "Stop-Cote" automatic sizing unit, shown in another of our illustrations (Fig. 29). In this unit, use is made of a mechanical application of the principle of measurement by the so-called null method, frequently used in electrical equipment. In it, a high-frequency generator energises a Wheatstone bridge circuit, which is symmetrical when the workpiece is the precise required size. This high-frequency output is amplified and fed to a relay. If there is any departure from the required size the gauge moves from the null position and causes an out-of-balance of the bridge, thus creating a current in the amplifier. This current, after being detected, stops the final feed stage. When the bridge is in balance—corresponding to exact size of the workpiece—the zero reading of the bridge permits a maximum current in the output stage, which energises the relay, withdrawing the grinding wheel.

The machine has a box-section worktable which runs on vee and roller ways sufficiently long to support it adequately throughout its full range of travel. It incorporates a lateral setting device for aligning the wheel to an existing thread. Determination of the required pitch is made by the appropriate combination of change gears relative to the leadscrew. A pitch correction device, which is fitted to advance or retard, as required, the resultant movement of the table, in effect, lengthens or shortens the pitch of the workpiece.

The wheelhead unit, comprising the wheel spindle and electric motors, is designed in the form of a drum which can be swivelled to allow the wheel to incline in the required plane for either left or right-hand helix. One of the two dynamically-balanced motors built into the head is a two-speed unit, which drives the wheel for the grinding operation. This same motor, at its lower speed, is used for the diamond dressing operation. The second motor is used solely for rotating the wheel at slow speed when wheel crushing is required.

The wheelhead is carried on rollers, running between flood lubricated vee and flat ways, movement being controlled by a precision feed screw and nut, operated by the large graduated handwheel on the front of the machine. For shoulder work, a means is provided to withdraw the wheel rapidly from the work at any predetermined setting.

The spindle and its casting constitutes a self-contained unit which is bolted to the front face of the swivelling drum. Removal and replacement of the internal grinding attachment, which is housed in a similar casting and located by the same bolts, is, therefore, a quick and simple operation.

The workhead has a live and a dead centre spindle allowing for centre, faceplate, chuck or collet work to be carried out. Change gears for obtaining the required pitch and

back gears for undertaking coarse lead work, are mounted in the workhead with a dividing arrangement for annular threaded work.

A 2in diameter hole runs through the centre of the spindle, and in it is housed the drawbar for collets. This hollow spindle will also admit shafts for chuck work. Provision is made for fitting an adjustable and graduated faceplate, for the indexing of high-precision multi-start threads, worms, helicoids, &c.

Both the jig borer and the gear grinder on the stand were exhibited at Olympia in 1948, and were described and illustrated in our issue of August 27, 1948.

A group of equipment has been arranged to show another aspect of the firm's activities, and it will include the "Matrix" internal diameter measuring machine; an optical dividing head complete with base and tailstock; the "Matrix" diameter measuring machine and "T.S." pitch measuring machine. In addition other instruments will be shown, together with a complete range of gauges, broaches and special cutting tools.

Alfred Herbert, Ltd.

We are informed by Alfred Herbert, Ltd., of Coventry, that because of the urgent demands for defence production and for export it has this year restricted its exhibits to two typical machines from the complete range it handles.

One of these two machines, the No. 14/36 combination turret lathe shown in Fig. 30, is the largest of the firm's range for dealing with heavy work up to 36in swing. In this machine, the headstock is driven by a two-speed, 12½/50 h.p. motor, giving sixteen reversible speeds, from 12 to 480 r.p.m. for turning, and five additional slow speeds, from 4 to 11 r.p.m. for screwing and reaming. Speed changes are made by two groups of two levers which operate sliding gears.

The saddle has sixteen reversible automatic sliding and surfacing feeds, 12·4 to 482 cuts per inch longitudinally, 13·8 to 540 cuts per inch transversely. The saddle feeds are independent of the turret slide feeds and a backlash eliminator fitted to the cross slide nut enables accurate tapers to be machined irrespective of the direction of feed. The turret slide has sixteen automatic feeds from 12·4 to 482 cuts per inch. Chasing mechanism is incorporated and the chasing gearbox provides three ratios to the leader. A quick-withdraw mechanism withdraws the chaser from the work at the same time as the nut is drawn from the leader. Lengths up to 15in can be chased on the machine.

A quick-power traverse is fitted for all motions and all controls are mounted on the respective aprons.

The other machine exhibited is the "No. 2 Flashcap" lathe, illustrated in Fig. 31. This machine is specially designed for high-speed production of brass and other non-ferrous components having internal or external threads, or both, requiring frequent spindle reversal at high speeds. Its motor control gear provides instantaneous starting, stopping and reversal of the spindle by operation of a fluted handwheel and knob at the front of the headstock, and, in addition, automatic change from forward or reverse can be effected by the movement of the capstan slide, when required.

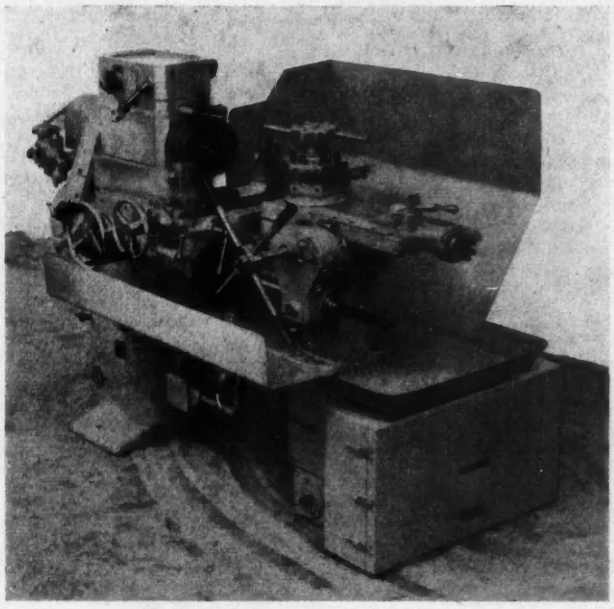


Fig. 31—"Flashcap" Lathe—Herbert

Automatic changes from forward to reverse are effected by push rods, which are mounted above the capstan and actuate a spring-loaded plunger in the headstock to operate the motor switch. The push rods can be set to effect an instantaneous change of direction at any desired point of the capstan slide travel. An adapter can be fitted to the push rods to enable two changes of spindle reversal to be obtained during the one forward and return motion of the capstan slide.

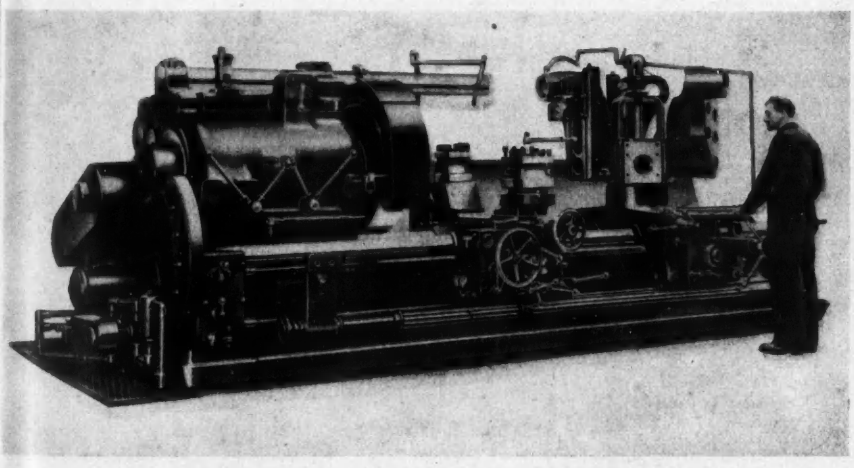


Fig. 30—Large Combination Turret Lathe—Herbert

The machine is driven by a 3 h.p. motor running at 1430 r.p.m., and a range of six spindle speeds, 630 to 2560 r.p.m., is available by means of pick-off gears.

In addition to these two machines there will be shown the firm's now well-known "Preoptive" headstock, a feed box as fitted to the makers' No. 8 combination turret lathe, two designs of electric chucks, and, on other stands, a comprehensive selection of measuring equipment, small tools and machine shop accessories.

E. W. Bliss (England), Ltd.

The automatic strip feed press which will be amongst the exhibits of E. W. Bliss (England), Ltd., City Road, Derby, is arranged for the production of end stampings for cans at a rate of 150 a minute. With these machines, one, two or three can ends can be accurately blanked and formed at every stroke, using single, double or triple dies.

These machines are built in three sizes, with 20 ton, 25 ton and 40 ton capacities, and are simple and economical in operation. In them, a self-contained vacuum pump and suction feed picks up the strips one at a time from the magazine, transfers them to a feed bar where accurately spaced fingers guide the work into the combination blanking and forming die. A cam-operated knock-out on the main slide ejects the can ends on the upward stroke.

Electric stops are furnished to stop the press immediately if two or more strips are fed at the same time or if, for any reason, a strip is prevented from feeding through the die.

Another press to be shown on the stand has a maximum capacity of 45 tons, a standard stroke of 2in, a shut height of 6½in, and normally operates from 100 to 300 strokes per minute, depending upon the type of work being performed and whether the press is of the flywheel type or single geared.

These presses have a four-piece tie-rod frame, with the crankshaft supported up to the crank pin in a heavy crown, to reduce vibration and deflection to a minimum. A long hook rolling key clutch or an air-operated friction clutch can be fitted. Ample space is available for die cushions and spring pads in the bed and presses can be fitted with precision double roll feeds and scrap cutters.

John Stirk and Sons, Ltd.

A good example of the clean, modern lines which have been introduced into the design of heavy machine tools is the latest all-electric double housing planing machine developed by John Stirk and Sons, Ltd., of Halifax, and illustrated in Plate 1.

This machine has a planing capacity of 10ft long by 42in wide by 36in high. Its continuous top plate bed carries the box-section table on large flat ways and a safety device is fitted to arrest the table quickly without shock should it overrun the driving gear owing to a mechanical or electrical

fault. This hydraulically-operated stop-and jack device can be engaged by the operator to push the table back and engage the gearing without other assistance.

The single-spiral table drive has a hardened and ground spiral gear meshing with a Meehanite rack and the gear is directly-coupled to the 32 h.p. slow-speed reversing motor. Cutting speeds from 40ft to 240ft per minute are available with quick return speeds from 160ft to 240ft per minute.

The tool boxes fitted on the heavy cross-slide are of universal, swivelling design, with a maximum slide movement of 10½in. Relief for the tool on the return stroke is provided, and the boxes can be set for converging and diverging motions as well as simultaneous movement in one direction. Through the feed box, mounted at the right-hand end of the cross-slide, eleven reversible feeds ranging up to ¾in can be obtained by the movement of two levers. Drive for the feed is provided by a 5 h.p. motor enclosed in the cross-rail together with the elevating gears. The same motor is used for raising and lowering the cross-slide, and for the rapid traverse of the tool boxes. Safety trips are provided for all motions, and the cross-slide has an automatic clamping arrangement, electrically interlocked with the elevating motion.

A side tool box of the same design and with the same feeds as those on the cross-slide heads is mounted on each column. These side boxes are balanced by weights enclosed in the uprights, so that no undue load is imposed on the traversing screws. Buttress uprights, of substantial proportions, house all the electrical equipment with the exception of the generator and starting gear.

All the controls are mounted on the upright at the operator's side, including the disc for setting the stroke. Graduations on this disc enable settings from a few inches upwards to be readily made. An accelerator switch is provided on the left-hand side of the machine for speeding up the table when there are gaps in the surfaces to be machined.

On this new machine improvements have been made in the electrical control gear to give reduced peak loads on reversal, and better performance on the high-speed range, with provision for increasing the cutting speeds after the cut has started when using cemented carbide tipped tools. Balanced swivelling pendant switches provided at both sides of the machine have push buttons for starting, stopping and inching the table, also to control all power traverses in both directions.

Lorant and Co., Ltd.

The " Universal Rindis " machine, made by Lorant and Co., Ltd., 98–100, Croydon Road, London, S.E.20, is claimed to be adaptable for some fifty different operations with the full range of accessories supplied by the firm, and six machines, set for different operations, are to be exhibited. The general design of the machine can be seen in Fig. 32, where it is arranged for horizontal milling. The machine has twenty-four spindle speeds, from 80 to 3400 r.p.m., the front of its hollow spindle being bored to take collets up to 1in capacity and the nose screwed to take a range of accessories.

The face of the head has a 7in register, and all the interchangeable units, such as horizontal milling attachment, vertical milling attachment, reciprocating slotting attachment, &c., are pulled on to this face with four bolts. The complete electrical equipment, including a 1¼ h.p. three-phase motor, push-button starting switch with overload protection, plug control switch for forward-stop-reverse, motorised centrifugal suds pump and low-voltage lighting unit, is standard.

A rising and falling compound slide, which is moved through two lead screws, is also fitted with a rack and pinion. The 14in long by 6½in wide table can be rotated through 360 deg., and it can be actuated by the rack and pinion not only parallel with the head,

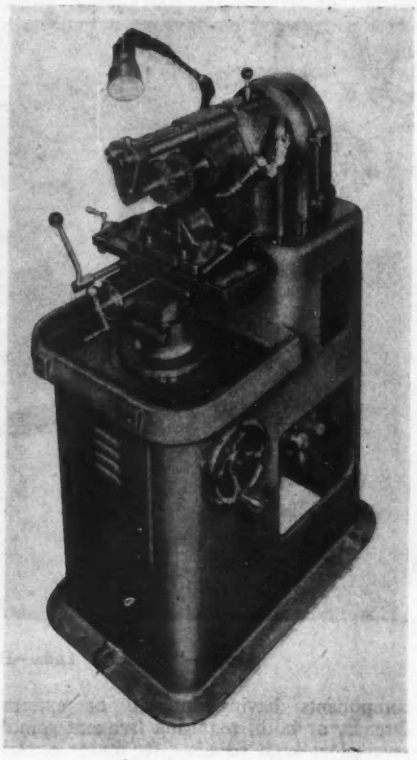


Fig. 32—Universal Machine Arranged as a Horizontal Miller—Lorant

for such work as surface grinding and milling, but also towards the head for internal grinding, vertical milling, &c., as well as for taper turning, cutting off angles and taper grinding. With this arrangement, it is possible to clamp a workpiece directly on to the table and carry out a range of different operations by changing the table position.

Gleason Works

Several of the machines made by Gleason Works of the United States, are to be shown upon the stand of Buck and Hickman, Ltd., and they will include some of new design.

One of these machines, the " Revacycle " bevel gear cutter was described in detail in our issue of August 27, 1948, when it was exhibited in this country for the first time. In this machine, bevel gear teeth can be generated in one cut from solid metal. It employs a large diameter disc cutter, the blades of which extend radially outwards from the cutter head. Each blade has two concave cutting edges, which produce convex profiles on the gear teeth. The cutter rotates in a horizontal plane and turns continuously at a uniform rate. During the cutting operation, the blank is held motionless, while the cutter is moved by means of a cam in a straight line across the face of the gear or pinion and substantially parallel to its root line. This motion makes it possible to produce the straight tooth bottom, and the desired tooth shape is produced by the combined effect of the motion of the cutter and the design of the cutter blades. There is no depthwise feed of the cutter into the work, the effective feed being obtained by making each cutter blade progressively longer than the one before it.

The cutter contains three kinds of blades—roughing, semi-finishing and finishing—and in one revolution completes each tooth space.

In the dual " No. 8 Revacycle " completing machine to be exhibited this year (Fig. 33) the tandem set-up has been developed for the production of large differential pinions where the depth of tooth is too large to be finished in one operation. In it roughing of the gear is carried out on one machine, and the workpiece is then automatically transferred to the other machine for finishing.

The No. 19 " Carvic " coupling grinder (Plate 4) is a completely automatic machine for grinding " Carvic " or " Zerol " face coupling teeth from the solid or on rough cut components up to 24in diameter. It is used primarily for the manufacture of face couplings on crankshafts and aero-engine assemblies, but is finding increasing application for cutting the compressor and turbine discs used in gas turbine engines.

In this machine the two sides and face of the wheel are dressed by three diamonds which are hydraulically operated and are adjustable for feed, wheel shape and diameter. The sliding base carrying the work table is hydraulically operated to and from the grinding position, and a double-acting hydraulic chuck is fitted. Speed is controlled by change gears and the rate of feed is regulated by means of cams. The automatic cycle can be set to repeat the same grinding sequence of work advance and wheel dressing throughout a work run. Before each run of work and

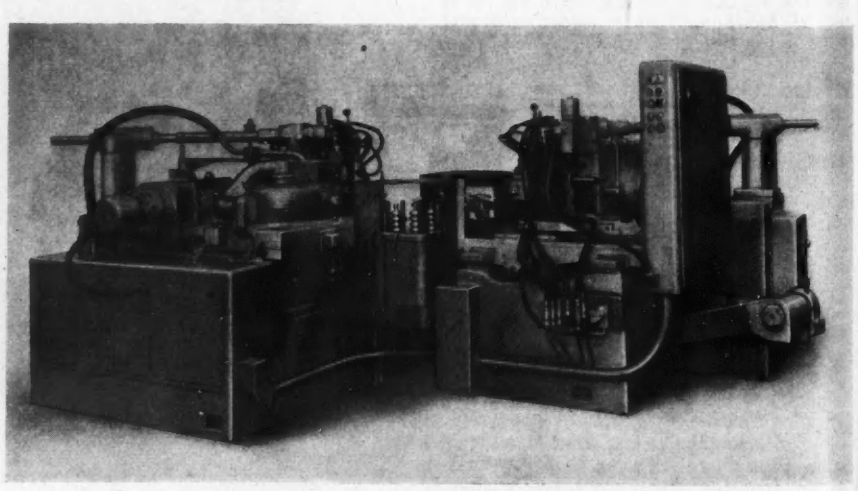


Fig. 33—Dual Straight Bevel " Revacycle " Unit—Gleason

when the required grinding cycle has been decided upon, an appropriate multiple stop drum or control cam is fitted on the automatic cycle control unit.

The multiple stop drum through which automatic work advance is effected has a series of steps of decreasing height ground into the inner face. After each complete grinding pass about a clutch, an electrically operated reversing valve changes the direction of the hydraulic pressure (which controls the movement of the sliding base), causing the

Fig. 34—Gear Quenching Machine—Gleason

sliding base to withdraw. The withdrawal of the base electrically actuates a ratchet lever, which indexes the drum for the next grinding pass. This cycle is repeated for each pass until the last tooth is ground. The machine is then automatically shut off by the tripping of a limit switch actuated by a button in the periphery of the stop drum.

A new air-operated quenching press for holding and quenching heated gears and other parts up to 25in outside diameter is illustrated in Fig. 34. In the sequence of operations on this machine the operator places the heated workpiece on the lower die, which is extended towards the front of the machine, as shown in the photograph. When the cycle is started by pressing a switch button the die is swung back into the quenching position under the upper die, and the upper die holder begins its downward stroke.

The upper die descends rapidly until it approaches the work, when it is automatically slowed down so that it contacts the hot workpiece gently. After engagement, full pressure is applied so that the work is mechanically aligned while still in the plastic state. As soon as the work is securely clamped, the flow of quenching oil around the piece begins. This flow continues according to a predetermined sequence of volumes and time intervals. The work is free to contract in the normal manner, but is always held true.

At the end of a preset time the automatic timing arrangement reverses the valves, the upper die moves vertically to its up position, and the lower die swings out to the unloading position.

The lower die, when in position for quenching, rests solidly on the base of the machine, and is seated on a hardened and ground taper in order to centre it accurately with the upper die. To obtain uniform quenching oil control rings are inserted in the universal lower die to permit full or restricted flow, or complete shut-off of the oil to any part of the work. The upper die is also designed to direct and govern the flow of oil.

It is possible to obtain a fast, drastic quench until the critical point of the hardening temperature is passed, followed by a slow quench to allow the temperatures on the outside surface and at the centre of the section of the part to equalise and to cool the material without internal stress and distortion, and finally a rapid cooling quench to bring the job down to the point where the operator can handle it. This sequence can be varied, depending on the quenching requirements of the particular job. A valve and timer system makes it possible to secure at each of the three stages the required volume of oil flow for the desired length of time.

George Swift and Sons, Ltd.

Two machines are to be exhibited by George Swift and Sons, Ltd., of Halifax—a "Swift-Sentinel" lathe and a "Swift-Summerskill" planing machine.

The lathe (Fig. 35) is one of the firm's 10½in heavy models, which swings up to 22½in over the ways or 14½in over the saddle and is made in two sizes, with or without gap beds, to take 5ft 6in or 7ft between the centres. These machines are of particularly rigid design with a headstock specially built to enable full use to be made of either cemented carbide tipped tools necessitating high-spindle speeds, or high-speed steel tools where lower spindle speeds, but heavier duty, is required.

The spindle, which is bored 2⅝in, is carried on three precision bearings—those at the front and centre being of preloaded taper roller design and that at the rear of plain roller construction. This bearing assembly is arranged to take thrust in both directions. Drive is taken to the spindle through a double-sided, multi-disc clutch which is used in conjunction with reverse gearing to give forward and reverse motion to the spindle by clutching without stopping the main motor. The gearing provides twelve rates of spindle speed, which is doubled by a two-speed motor giving ranges from 7½ to 500, or 10 to 670, or 15 to 1000 r.p.m., as specified.

A totally enclosed Norton feed box gives thirty-six feeds from twenty-nine to 400 cuts per inch, with a similar number of English pitches from two to twenty-eight threads per inch, or, in metric, 1mm to 15mm. Provision is made for cutting special pitches by the use of change wheels.

The saddle carries a surfacing slide indexed in degrees upon which is mounted a swivel slide with a four-way turret toolpost. This toolpost has three sides gashed for turning tools and the fourth side bored out for the reception of drills, reamers, boring bars, &c.

The planing machine to be seen in Plate 1 takes work up to 16ft by 4ft by 3ft 6in. Its table is driven through the medium of high-tensile steel, single helical reduction gearing and a high-tensile iron table rack. Cutting and return speeds from 25ft to 200ft per minute are available through a Ward-Leonard drive, in which a speed range of 8 to 1 is given by shunt field and voltage control to the main reversing motor of 25 h.p. An accelerating device enables the table to be speeded up to the return speed irrespective of the setting of the cut controller—a factor which can be used to advantage when machining faces situated some distance apart.

In the toolboxes the base slide is extended to give additional support to the swivel slide, and the down slide completely envelops the swivel slide. If required, automatic relief to the toolboxes on the return stroke can be provided, and an electric solenoid built into the down slide enables it to function irrespective of angular setting.

Attention is called to the electric feed and quick power traverse motion fitted to the machine in order to enable it to make the best possible use of the advantages of tungsten carbide tools. This new feed unit enables eighty feeds from 0·005in to 0·450in being obtained in increments of 0·005in by simply moving one handle whilst the machine is running or is stopped. The feed unit is actuated by a built-in electric motor and contactor panel, which, in turn, is controlled from the main contactors governing table reversal. Feed is applied instantaneously at the moment of reversal in less than 2in of table stroke. The automatic power feed can be applied to the cross-slide toolbox and down slides at any angle. As separate clutches are fitted for engaging or disengaging the feed motion, the toolboxes can be fed independently or simultaneously, either in the same direction or towards or away from each other. Quick power traverse to the toolboxes is also provided and interlocks prevent this being engaged whilst the machine is running.

A pendant push button operates the automatic control cabinet, which incorporates the various rheostats governing the speeds, the accelerating device, the con-

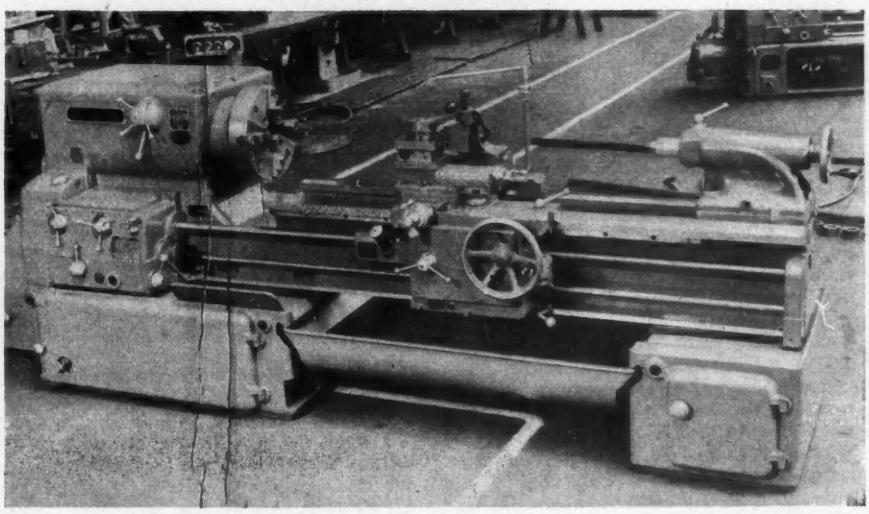


Fig. 35—10½in Heavy Lathe—Swift

tactors for the reversal and ancillary circuits, &c.

Midgley and Sutcliffe, Ltd.

The six machines to be displayed on the stand taken by Midgley and Sutcliffe, Ltd., Hunslet, Leeds, will include three of the firm's well-known "Richmond" universal millers, and three radial drilling machines. From the accompanying photograph of the most

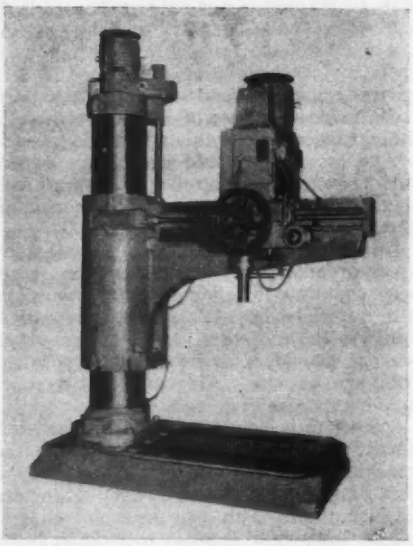


Fig. 36—Radial Drilling Machine—Midgley and Sutcliffe

recent design of the radial drilling machines (Fig. 36), it can be seen how clean modern lines have been combined with strong construction and grouped controls have been arranged to speed and facilitate operation.

This machine is made in two models, with 5ft and 6ft radii and saddle traverses of 40in and 50in respectively. The arm is carried on the pillar on annular roller bearings at the top and bottom of the long barrel support portion and it is moved over its 15in travel through an elevating screw driven by a separate motor at the top of the column. All mechanism is totally enclosed in the saddle, which is carried on large bearing surfaces and is mounted on needle roller bearings to permit easy traverse along the arm through rack and pinion gearing.

The 6 h.p. motor of the saddle drives the spindle through gearing and two alternative ranges of twelve spindle speeds—from 20 to 960 r.p.m., or 15 to 720 r.p.m.—can be provided. Quick hand traverse, fine hand feed and four automatic spindle speeds are available and there is an automatic depth stop.

Elgar Machine Tool Company, Ltd.

Several of the imported machine tools to be seen upon the stand of the Elgar Machine Tool Company, Ltd., Hampton Road, Hanworth, Middlesex, are new to this country. Amongst these machines is the Busch slot drilling and keyway milling machine (illustrated in Fig. 38), which can be adapted for a number of operations as well as many forms of vertical milling. It has a table 31in long by 14in wide, with a hand-operated longitudinal traverse of 16in, a cross traverse of 7¾in, and a vertical movement of just under 8in. The head is carried on slides and has hydraulically-operated traverses of 8in longitudinally and 6in transversely. The spindle is driven by a 2 h.p. motor and has four speeds from 380 to 1930 r.p.m.

The Zetto internal and external grinding machine (Fig. 37) is of simple straightforward

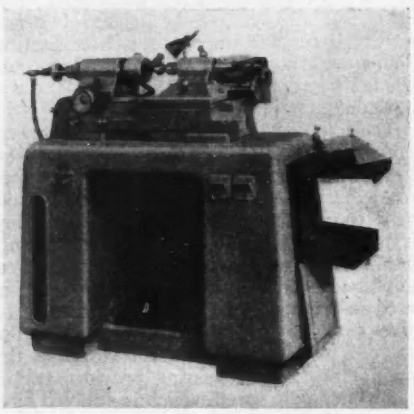


Fig. 37—Grinding Machine—Elgar

design for precision grinding of work up to 2in external and 3½in internal diameter, up to 4in long. For internal work a range of air motor-driven spindles with speeds from 40,000 to 120,000 r.p.m. are stated to be available. An automatic feed of 0·00004in is incorporated and the makers claim that grinding can be done on the machine to a tolerance of 0·0002in and concentric within 0·00008in.

A model of the well-known Boley and Leinen precision capstan lathe on this stand incorporates improvements, including a new drive in which speed changes are

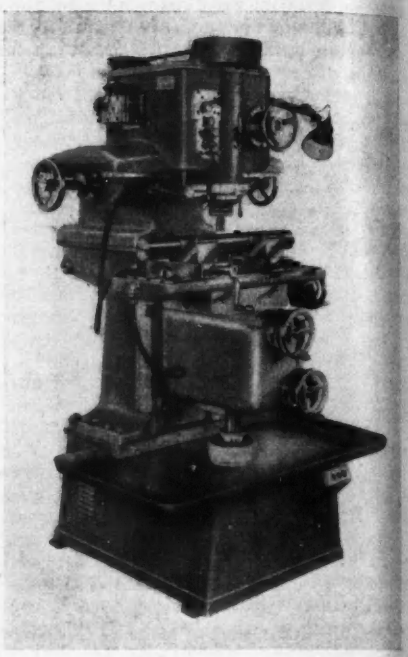


Fig. 38—Slot Drilling and Keyway Milling Machine—Elgar

effected by a pole-changing motor all-geared unit. A Mannaioni automatic long screwing machine to be shown can be used for work up to 28in long with threads 20in long. It has twelve spindle speeds, from 70 to 2000 r.p.m., and in it the leads are obtained from a lead screw which has to be a multiple of the thread being cut. A British machine to be exhibited is the "Panda" grinder for die sinking and end mill cutters made by Projects and Developments, Ltd., of Blackburn. This machine was developed as a result of the increased use being made of copy milling machines, and on it radii can be reproduced to identical shape both on tracers and milling cutters.

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